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OFFICE OF WATER RESEARCH AND TECHNOLOGY

# SELECTED WATER RESOURCES ABSTRACTS

VOLUME 14, NUMBER 23
DECEMBER 1, 1981

W81-05701 -- W81-06050
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A semimonthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

# PREFACE

**Selected Water Resources Abstracts,** a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

**Selected Water Resources Abstracts** is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthly updates are available also in magnetic tape through lease from NTIS.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

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# SELECTED WATER RESOURCES ABSTRACTS

## 1. NATURE OF WATER

### 1A. Properties

**COSEISMIC CHANGES IN GROUNDWATER TEMPERATURE OF THE USU VOLCANIC REGION,**
Hokkaids Univ., Sapporo (Japan). Geophysical Inst.
H. Shimamura, and H. Watanabe.
Nature, Vol 291, No 5811, p 137-138, May, 1981. 3 Fig, 1 Tab, 2 Ref.

Descriptors: *Seismology, *Water temperature, *Earthquakes, Seismic waves, Earthquakes, Engineering, Grundwater, Temperature, Well water, Deep wells, Volcanoes, Seismographs, Geophysics.

The Usu volcanic region of Japan was studied to monitor the crustal strain and/or the movement of groundwater connected with the occurrence of earthquakes. Thirty wells in various areas of impending earthquakes in Japan have been monitored for groundwater temperature with the Usu thermometer to an accuracy of 0.001 degrees or greater. When a thermometer of this type was installed at a depth of 200 m in the active volcano where there was an upward movement of magma, a trend of increasing temperature (0.3 degrees) was found over a six month period. The rate of increase preceding intense local earthquake activity was found to decrease, while temperature increases were accompanied by large local earthquakes with magnitudes up to 4.2. The polarity of the steps corresponded to the location of the hypocenter. It was suggested that the monitoring of groundwater temperature may be a promising technique for predicting seismic activity. (Geiger-FRC)
W81-05843

## 2. WATER CYCLE

### 2A. General

**CONDITIONAL FLOW SIMULATION: A STOCHASTIC FORECAST MODEL,**
Science and Education Administration, Boise, ID. Northwest Watershed Research Center.
J. F. Zuzel.
Water Resources Research, Vol 17, No 3, p 595-601, June, 1981. 10 Fig, 5 Tab, 4 Ref.

Descriptors: *Snow water equivalent, *Streamflow forecasting, *Model studies, Simulation studies, Stochastic process, Forecasting.

A stochastic conditional flow simulation model was formulated, verified, and used to generate probability distributions of snow water equivalent values and monthly and longer-term flow volume distributions at a snow course site. The model requires no basin calibration and runs in 15 sec using little computer storage space. Verification was done using 33 years of snow water equivalent data for January-May and 28 years of data for June from Mores Creek Summit snow course. Runoff volumes for 33 years were available from a Boise River gaging station. The model was then used to forecast streamflow volume for February 1, March 1, and April 1 for 1978 and 1979. Monthly forecasts were generally within the probability distributions generated by the model and near the 0.50 exceedance probability level. (Cassar-FRC)
W81-05816

**PARAMETRIC-DETERMINISTIC URBAN WATERSHED MODEL,**
Geological Survey, Reston, VA.
W. M. Alley, D. R. Dawdy, and J. C. Schaake Jr.
Journal of the Hydraulics division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY5, p 679-690, May, 1980. 4 Fig, 28 Ref.

Descriptors: *Mathematical models, *Rainfall-runoff relationships, Urban runoff, Runoff, Rainfall impact, Rainfall infiltration, Hydrography, Gages, Mathematical studies, Watersheds, Drainage area, *Urban watersheds.

A rainfall-runoff model is described which attempts to represent the units and processes of an urban watershed system as well as to provide operational characteristics that enhance the model's value for practical applications. Input to the model includes daily rainfall, daily pan evaporation, and a physical definition of the drainage basin discretized into as many as 50 segments, such as overland flow and reservoir segments. The model generates a simulated discharge hydrograph based on rainfall data from rain gages. The model is made up of two sets of components: the parametric rainfall-excess components and the deterministic runoff-routing components. The Philip equation is used to determine antecedent-moisture conditions and to compute infiltration. Kinematic-wave theory is used for routing of flows over contributing areas and through a branched system of channels and/or pipes to a watershed outlet. Soil-moisture and infiltration parameters can be calibrated using a modified Rosenbrock optimization technique. Model segments can be arranged into a network to model many complex drainage basins. (Small-FRC)
W81-05898

**NEW ROUTING MODEL FOR CONTINUOUS RUNOFF SIMULATION,**
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
M. S. K. Chowdhury, and F. C. Bell.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 489-500, April, 1980. 5 Fig, 12 Ref.

Descriptors: *Mathematical models, *Runoff, Routing, *Flood forecasting, *Flood routing, Hydrography, Watersheds, Mathematical equations, Flooding, Planning.

A simple method of runoff routing is presented based on the kinematic wave approximation and a catchment representation similar to that of Wooding. In this model, the partial differential equations of channel flow are replaced by a total differential equation at the catchment outlet. Thus, spatial and temporal distribution of rainfall excess is allowed for as well as a wide range of channel and catchment surface characteristics. The models's small number of parameters have reasonably clear physical significance. Current discharge is used as a state variable which enables the model to be conveniently tuned to current conditions. Thus, it should be particularly useful in short-term flood forecasting operations. The model was tested with data from two experimental catchments, and there was close agreement between observed and predicted hydrographs. (Small-FRC)
W81-05899

**EVALUATION OF SHORT SERIES OF DISCHARGE MEASURMENTS BY MEANS OF LONG RECORDS OF WATER LEVEL AND RAINFALL (VALORISATION DE BREVES DUREES D'OBSERVATIONS DE DEBITS AU MOYEN DE LONGUES SERIES LIMNIMETRIQUES ET PLUVIOMETRIQUES),**
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
J-M. Masson, and G. Bediot.
Hydrological Sciences Bulletin, Vol 26, No 1, p 47-69. March, 1981. 6 Fig, 32 Ref.

Descriptors: *Rainfall rate, *Rivers, River systems, Water level fluctuations, Rainfall, Hydrologic data collections, Meteorological data collections, France, *Steam discharge.

Rainfall depths and water levels in rivers in France have been recorded since the middle of the nineteenth century and can be used for completing recent records of discharges of rivers on plains. First, the homogeneity of a long series must be verified, and the reliability of the double mass method must be established. A long, reconstructed series of mean daily discharge quantities at a proposed dam site is used, based on the available long term data. The data series generated is directly usable to determine the dimensions of storage and flood control reservoirs and to develop real time forecasting models. The cost of computerized storage of this historical data is negligible when compared to the costs of the projects it will be used to design. (Small-FRC)
W81-05925

**PHYSICAL BASIS OF STOCHASTIC MODELS OF ANNUAL FLOWS,**
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. D. Salas, and R. A. Smith.
Water Resources Research, Vol 17, No 2, p 428-430, April, 1981. 22 Ref.

Descriptors: *Watersheds, *Stochastic process, Mathematical studies, *Surface-groundwater relations, Probabilistic process, Stochastic hydrology, Model studies, Streamflow, Flow, Groundwater storage.

The conceptual watershed model suggested by Thomas and Fiering is used to show that the groundwater storage and the streamflow processes belong to the general class of autoregressive and moving average (ARMA) processes. The order of the ARMA process depends on the type of precipitation process. If the precipitation is an independent process, the groundwater storage is an AR process and the streamflow is an ARMA process. In general, such groundwater and streamflow ARMA processes have a restricted parameter space. The results presented in this paper indicate that the identification or selection of the type of stochastic model for streamflow simulation can be substantiated by simple physical considerations of the watershed system. (Baker-FRC)
W81-05955

**TRANSPORT OF ORGANIC CARBON IN THE WORLD'S RIVERS,**
Duke Univ., Durham, NC. Dept. of Botany.
W. H. Schlesinger, and J. M. Melack.
Tellus, Vol 33, No 2, p 172-187, April, 1981. 3 Fig, 3 Tab, 101 Ref.

Descriptors: *Carbon, *River flow, Oceans, Sediment transport, Rivers, *Organic carbon, Particulates, *Carbon cycle, Model studies, Equations, Estimating.

One of the smaller, but poorly studied, transfers of carbon in the global cycle was investigated, the transport of dissolved and particulate organic carbon to the world's oceans by riverflow. Past estimates of the total organic carbon flux in world rivers vary by nearly two orders of magnitude. To predict the total world river organic carbon transport the equation for the logarithmic regression was applied to calculate carbon load for those rivers among the fifty largest for which no carbon data are available. A second approximation was based on the denudation rate of terrestrial watersheds with respect to organic carbon. Estimates derived from these methods of the organic carbon transported in the world's rivers range from 0.37 to 0.41 times ten to the 15th power g/year. The fate of freshwater organic carbon upon entering the oceans is not well understood. Some is undoubtedly oxidized. This is but a small flux in the global total carbon cycle. (Baker-FRC)
W81-05991

**USE AND MODIFICATION OF A SIMPLE RAINFALL-RUNOFF MODEL FOR WET TROPICAL CATCHMENTS,**
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
R. J. Higgins.
Water Resources Research, Vol 17, No 2, p 423-427, April, 1981. 8 Fig, 4 Tab, 9 Ref.

Descriptors: *Tropical regions, *Rainfall-runoff relationships, *Model studies, *Catchment areas, Catchment basins, Basins, Watersheds.

The nonavailability of data is a major problem in the application of general purpose rainfall-runoff models. By adopting a simple model structure

which recognizes the particular characteristics of wet tropical catchments, this constraint is minimized for these catchments, particularly in view of the low variability of many parameters. An exponential decay function is employed in a linear rainfall-runoff model. Parameters of the model are seasonal. A model variant makes simple allowance for evaporation and base flow. It is also possible to allow for the unknown systematic difference between the observed rainfall at a point and the catchment average rainfall. In many situations, the development of specific purpose models is likely to be a viable procedure for reducing expensive and delay-inducing data collection programs needed to satisfy the requirements of general models. (Baker-FRC)
W81-05992

**THE INFILTRATION-SOIL WATER STORAGE RELATIONSHIP AT A POINT IN WATERSHED MODELING,**
Control Data Australia Party Ltd., North Sydney, New South Wales.
P. H. I. Bloomfield, D. H. Pilgrim, and K. K. Watson.
Water Resources Research, Vol 17, No 2, p 370-376, April, 1981. 7 Fig, 4 Tab, 15 Ref.

Descriptors: Rainfall, Ponding, Watersheds, *Model studies, *Infiltration, *Rainfall-runoff relationships, Runoff, *Soil water, Water storage.

Most deterministic watershed models developed for synthesizing runoff from rainfall on a continuous basis use a single-valued relationship between infiltration capacity and soil water storage. This type of relationship is examined using results from a numerical solution of the partial differential equation governing flow in unsaturated soil for a profile of uniform initial water content under ponded conditions. A nonunique relationship is demonstrated between infiltration capacity and soil water storage. This suggests that models employing a single-valued relationship contain a serious conceptual and practical error. The nonunique relationship, which can also be derived from the Philip equation, can be represented by simple empirical infiltration equations for practical application in deterministic watershed modeling. However, the parameters of these equations depend on the initial soil water content, the time interval used in calculations, and the soil store capacity. The nonunique relationship between infiltration and soil water storage is also demonstrated to be applicable to modeling infiltration under rainfall conditions. (Baker-FRC)
W81-05994

**THE STATE OF THE WORLD'S TROPICAL FORESTS,**
A. Grainger.
Ecologist, Vol 10, No 1, p 6-54, January, 1980. 22 Fig, 7 Tab, 143 Ref.

Descriptors: *Rain forests, *Forest management, *Ecological effects, *Tropical regions, Erosion, Silting, Dams, Logging, Rainfall, Climatology, Agriculture, Construction, Environmental effects, Public health, Social impact, Deserts, Hydrologic cycle, Laterites, Floods, Carbon cycle.

A comprehensive review discusses the geography, populations, plant and animal life, and current exploitation of tropical rain forests, and the cultural, biological, climatic, and ecological effects of deforestation. Destroying the rain forests can turn a wet landscape into a desert because the soils under rain forests are poor, depending on a rapid turnover of plant matter to replenish nutrients. Deforestation can cause local climatic changes. For example, converting Malaysian rain forests to rubber plantations did not change the total annual rainfall, but rainfall events were fewer and more intense. Loss of forests affects various stages of the water vapor cycle--watershed catchment, river drainage, wetland storage, and ocean sink. Vegetation on hillsides lessens the impact of raindrops, greatly decreases soil erosion and river silting, and stabilizes the volume of water in the drainage system. In Southeast Asia, population, farming, and logging expansion to previously forested areas has produced heavy silting in rivers and dams, reducing the life expectancy of the Ambukla Dam, Phillipines, from 60 years to 30 years. Similar problems plague Peru, Bolivia, and Colombia, where erosion, landslides, and sedimentation produce flooding regularly in areas where this did not occur in the past. Higher peak flood levels and silting threaten development schemes in agriculture, mining, and hydroelectric power. On a global scale, extensive deforestation would increase the amount of heat lost by reflection, decrease that lost by evapotranspiration, and produce dust in the air, further reducing the solar energy reaching the earth's surface. Thus rainfall at the equator would decrease, rainfall near the Tropics would increase, Britain, Northern U.S. and Canada would be drier, and the whole earth would become cooler. Proper respect for and management of the world's forests is a key to preventing civilization's decline. (Cassar-FRC)
W81-06015

**SOIL HYDRAULIC PROPERTIES AND THEIR EFFECT ON SURFACE AND SUBSURFACE WATER TRANSFER IN A TROPICAL RAINFOREST CATCHMENT,**
James Cook Univ. of North Queensland, Townville (Australia). Dept. of Geography.
M. Bonell, D. A. Gilmour, and D. F. Sinclair.
Hydrological Sciences Bulletin, Vol 26, No 1, p 1-18, March, 1981. 10 Fig, 5 Tab, 35 Ref.

Descriptors: *Rainfall-runoff relationships, *Tropical regions, *Forest hydrology, Surface runoff, Forest watersheds, *Soil properties, Litter, Rainfall intensity, Saturated flow, Overland flow, Australia, Surface-groundwater relations.

The spatial and temporal heterogeneity of the surface, subsurface and vertical drainage components within and between three sites in a tropical rainforest catchment (25.7 ha) were investigated. In the experimental catchment, average rainfall was 4239 mm, with 63% occurring during the summer months. The effects of runoff were demonstrated. Saturated overland flow depended on the close interaction between temporal variations in rainfall intensity, the upper soil store capacity, and the spatial variations of saturated hydraulic conductivity. Thus, during storms, saturated overland flow occurs on the upper slopes and is confined to rainfall intensity peaks in the lower area. Regression models demonstrated that rainfall pulse shape was an important factor in determining the proportion of upper soil store capacity occupied by water. Cross-correlation coefficients indicated that this was a very sensitive environment. Short lag response between rainfall and the lateral and vertical drainage components was due to high rainfall intensities, sparsely littered forest floor, large volume of biopores in the topsoil, high antecedent soil moisture, steep slopes, and a rapid increase in drainage density in the early part of storms. A combination of meteorological and soil hydraulic properties produced the unusual drainage responses. (Small-FRC)
W81-06050

## 2B. Precipitation

**KRIGING ANALYSIS OF MEAN ANNUAL PRECIPITATION, POWDER RIVER BASIN, MONTANA AND WYOMING,**
Geological Survey, Tacoma, WA. Water Resources Div.
M. R. Karlinger, and J. A. Skrivan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-216806, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigation 80-50, 1981. 25 p, 7 Fig, 1 Tab, 11 Ref.

Descriptors: *Statistical methods, *Precipitation, *Regional analysis, Estimating equations, Hydrologic data, Network design, Contours, *Montana, *Wyoming, Powder River basin, *Kriging, Universal kriging, Stochastic interpolation.

Kriging is a statistical estimation technique for regionalized variables which exhibit an autocorrelation structure. Such structure can be described by a semi-variogram of the observed data. The kriging estimate at any point is a weighted average of the data, where the weights are determined using the semi-variogram and an assumed drift, or lack of drift, in the data. Block, or areal, estimates can also be calculated. The kriging algorithm, based on unbiased and minimum-variance estimates, involves a linear system of equations to calculate the weights. Kriging variances can then be used to give confidence intervals of the resulting estimates. Mean annual precipitation in the Powder River basin, Montana and Wyoming, is an important variable when considering restoration of coal-strip-mining lands of the region. Two kriging analyses involving data at 60 stations were made--one assuming no drift in precipitation, and one a partial quadratic drift simulating orographic effects. Contour maps of estimates of mean annual precipitation were similar for both analyses, as were the corresponding contours of kriging variances. Block estimates of mean annual precipitation were made for two subbasins. Runoff estimates were 1-2 percent of the kriged block estimates. (USGS)
W81-05735

**ECONOMICS OF RAINFED CROPPING SYSTEMS: NORTHEAST THAILAND,**
Ford Foundation, Bangkok (Thailand).
For primary bibliographic entry see Field 2I.
W81-05818

**DETERMINATION OF RAINFALL DURATION STATISTICS FOR RAIN-OUT MODELS FROM DAILY RECORDS,**
Washington Univ., Seattle. Dept. of Civil Engineering.
K. Alexander.
Water Resources Research, Vol, 17, No 3, p 521-528, June, 1981. 4 Fig, 8 Tab, 13 Ref.

Descriptors: *Rainfall distribution, *Statistics, Model studies, *Air pollution, Meteorological data collection, Rainfall duration, Atmospheric pollutants.

Rain-out models, concerned with contamination of rainwater by atmospheric pollutants, require data describing the occurrence of rainy and dry episodes. Two methods are examined: (1) the method of moments applied to the mean and variance of the fraction of a fixed time period during which it is raining, and (2) maximum likelihood estimates from weather observations at regular intervals. Generally, the maximum likelihood method gives better estimates than the method of moments for the same data, but both give good results. Analyzing the method of moments for a 25-year record at Spokane, Washington, and a 21-year record from Olympia, Washington, gave better results for Spokane because storms have a greater interval between them than in Olympia, where light rain or drizzle is frequently falling. Rainfall duration statistics can be estimated for many localities within 10-15% on the basis of 15-30 years of daily records for monthly distributions and 8-15 years for seasonal distributions. (Cassar-FRC)
W81-05820

**A STOCHASTIC MODEL FOR THE TIME DISTRIBUTION OF HOURLY RAINFALL DEPTH,**
Ecole Polytechnique, Montreal (Quebec). Dept. of Civil Engineering.
V-T-V. Nguyen, and J. Rousselle.
Water Resources Research, Vol 17, No 2, p 399-409, April, 1981. 13 Fig, 3 Tab, 20 Ref.

Descriptors: *Storms, *Stochastic process, Mathematical studies, Storm water, Storm runoff, Hydrology, Model studies, Probabilistic process, Rainfall, *Rainfall intensity, Rainstorms, Cloudbursts, *Rainfall distribution.

A probabilistic characterization of temporal storm patterns is presented in which a storm is defined as an uninterrupted sequence of consecutive hourly rainfalls. The probability distribution of rainfall accumulated at the end of each time unit within a total storm duration is determined by a proposed

stochastic model. Using a 32-yr hourly rainfall record at Dorval Airport on Montreal Island, the model was given a practical application. Hourly rainfall depth was assumed to be an exponentially distributed random variable. The probability of any given number of consecutive rainy hours was determined by first- and second-order Markov chains. In order to test the fit of the Markov model to the sequence of wet hours statistical tests were performed. The agreement obtained between the observations and the proposed model is discussed. The methodology used in this study is more flexible and general in nature than methods used in earlier investigations. By using the stochastic model demonstrated, a storm profile can be characterized in terms of the time of occurrence of the storm, the total depth of the storm, and the estimated probability of accumulated rainfalls at the end of each time unit within the total storm duration. (Baker-FRC)
W81-05956

## 2C. Snow, Ice, and Frost

**CLOSED-SYSTEM FREEZING OF SOILS IN LININGS AND EARTH EMBANKMENT DAMS,**
Water and Power Resources Services, Denver, CO. Engineering and Research Center.
For primary bibliographic entry see Field 8D.
W81-05754

**SNOW SURFACE ENERGY EXCHANGE,**
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
D. H. Male, and R. J. Granger.
Water Resources Research, Vol 17, No 3, p 609-627, June, 1981. 12 Fig, 6 Tab, 107 Ref.

Descriptors: *Snowmelt, *Energy transfer, *Turbulent flow, *Solar radiation, Literature review, Streamflow, Radiation, Heat transfer, Latent heat, Model studies, Simulation analysis, Forests, Air masses, Albedo, Cloud cover, Prairies, Evaporation.

A review of the literature on snowmelt emphasizes ideas and data potentially useful in simulation studies. It concentrates on two of the processes for exchanging energy at the snow surface--radiation transfer (short- and long-wave) and turbulent exchange (sensible and latent heat transfer). The radiation exchange is the dominant energy transfer process during snowmelt on the prairies, in nothern forests, and in mountainous areas. Method for modeling radiation on an areal basis are accurate for clear days in open spaces. However, there is a scarcity of measured data for verification. Forest cover or cloudy skies cause complications which may be compensated for to a certain extent. Sensible and latent heat transfer have been measured at a variety of sites throughout the world, But technology in this field is less advanced than that of radiation exchange. The relative importance of radiation transfer and turbulent exchange is influenced by prevailing air mass conditions, altitude, season, and terrain features. The area of research most likely to yield practical results in the near future involves air mass influences. (Cassar-FRC)
W81-05811

**AUTOMATED SYSTEM FOR COLLECTING SNOW AND RELATED HYDROLOGICAL DATA IN MOUNTAINS OF THE WESTERN UNITED STATES,**
Soil Conservation Service, Washington, DC. Engineering Div.
For primary bibliographic entry see Field 7B.
W81-05833

**SHORT-TERM FLUCTUATIONS IN HEAVY METAL CONCENTRATIONS IN ANTARCTIC SNOW,**
British Antarctic Survey, Cambridge (England); and Natural Environment Research Council, London (England).
For primary bibliographic entry see Field 5B.
W81-05842

**RECENT GLCIER VARIATIONS AND VOLVANIC ERUPTIONS,**
Washington Univ., Seattle. Quaternary Research Center.
For primary bibliographic entry see Field 5B.
W81-05844

## 2D. Evaporation and Transpiration

**VARIATIONS IN CLIMATIC CHARACTERISTICS AS RELATED TO EVAPOTRANSPIRATION IN SOUTH PARK, CENTRAL PARK COUNTY, COLORADO,**
Geological Survey, Lakewood, CO. Water Resources Div.
N. E. Spahr.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-219610, Price codes: A08 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-86, 1981. 154 p, 12 Fig, 7 Tab, 12 Ref.

Descriptors: *Climatology, *Evapotranspiration, *Consumptive use, Data collections, Air temperature, Pan evaporation, Wind, Relative humidity, Solar radiation, Precipitation, *Colorado, Central Park County, South Park.

Data collected from May through September in 1977, 1978, and 1979 at three stations were analyzed using an analysis of variance technique to determine variations in climatic characteristics in South Park, Colo. Knowledge of these climatic characteristics will aid in determining the amount of water that may be transferred from agricultural use in South Park to municipal use in the Denver metropolitan area. Daily minimum air temperature, daily average air temperature, cumulative wind, daily relative humidity, and daily solar radiation were statistically different between the three stations at the 1-percent level of significance. Daily maximum air temperature and daily pan evaporation were not significantly different between some stations. Daily precipitation was not significantly different between the three stations. Estimates of potential evapotranspiration made using the Penman equation were not significantly different between the three stations. The lack of spatial variations in the estimated potential evapotranspiration shows that no one climatic characteristic can be used as an indicator of spatial variation of potential evapotranspiration. Large variations in solar radiation between the three stations indicate that solar radiation needs to be measured at sites where evapotranspiration is being determined. (USGS)
W81-05733

**EVAPOTRANSPIRATION FROM RAPIDLY GROWING YOUNG SALTCEDAR IN THE GILA RIVER VALLEY OF ARIZONA,**
Geological Survey, NSTL Station, MS. Water Resources Div.
O. E. Leppanen.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-485, 1981. 26 p, 5 Fig, 1 Tab, 4 Ref.

Descriptors: *Evapotranspiration, *Heat balance, *Soil water, Micrometeorology, Transpiration, Data collections, *Arizona, Gila River Valley, *Saltcedar, San Carlos Reservoir.

Estimates of evapotranspiration by young saltcedar, based on energy budget measurements, were made for an unfilled portion of the San Carlos Reservoir in east-central Arizona. Foty-eight days of record were obtained before the site was inundated. The young saltcedar, which had grown from seed earlier in the season, had an average daily evapotranspiration of 5.8 millimeters of water during the period August 17, 1971, to October 3, 1971. Daily values ranged from 9.2 millimeters to a low of 0.23 millimeters which occurred during a stormy day. (USGS)
W81-05738

**WATER RELATIONS OF POPULUS CLONES,**
Wisconsin Univ., Madison. Dept. of Forestry.
S. G. Pallardy, and T. T. Kozlowski.
Ecology, Vol 62, No 1, p 159-169, February, 1981. 7 Fig, 3 Tab, 41 Ref.

Descriptors: *Populus clones, *Water balance, *Drought resistance, Trees, Evapotranspiration, Stomata, Groth rates, Soil moisture, Water poentials, Solar radiation, Light intensity, Leaves, Water stress, Poplar, Adaptation, Plant water potential, Plant groth, *Cottenwood trees, Wisconsin.

Stomatal aperture and water balance of 8 Populus clones, varying in growth rate, were studied in 1976 and 1977 near Rhinelander, Wisconsin. Effects of environmental factors and clonal differences were evident. Leaf water potential was influenced by solar radiation, leaf conductance, evaporative demand, and soil moisture content. Several slow-growing clones had extendedj periods of leaf water poential lower than that of rapidly-growing clones, despite the latter's high evaporative demand and greater transpiring surfaces. Changes in light intensity and vapor pressure gradient produced stomatal responses in all clones. Two rapidly-growing clones with drought resistant parents showed pronounced stomatal sensitivity to vapor pressure gradients. Seasonal maximum leaf conductance was positively related to growth, suggesting that the rapidly-growing clones can carry on higher rates of gas exchange under favorable conditions. For four clones the change in leaf water potential per unit change in transpirational flux density (TPD) decreased as TFD increased, showing protective plant adaptation. (Cassar-FRC)
W81-05878

**THE EFFECT OF THE EVAPORATION RETARDANT 'KARMIDOL' ON THE BACTERIOPLANKTON OF RICE PADDIES,**
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potapova.
Hydrobiological Journal, Vol 16, No 1, p 51-55, 1980. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Evaporation rate, *Water, *Pollutants, Organic compounds, Plankton, Bacteria, Saprophytic bacteria, Toxicity, Evaporation suppressants, Higher alcohols, *Evaporation control, Rice.

Alterations in two of the structural indicators of the rice paddy bacterioplankton under the influence of the polyatomic alcohol Karmidol were investigated. The indicators were the total abundance of bacteria and the abundance of saprophytes. The major purpose of the study was to investigate the effect of Karmidol on the bacterioplankton, as one of the main biological components of rice paddies. Field observations were carried out in summer 1977 and May 1978. These findings demonstrate that a stimulating role of Karmidol is not noted when bacteria develop on a mineral medium rich in nutrients. Regarding the role of individual components of the evaporation suppressant, it is evidently possible to note a combined effect of higher aliphatic alcohols (HAA) and urea on saprophytic bacteria and the utilization by the latter of these components as sources of carbon and energy for their development. It is also probable that the higher aliphatic alcohols play the greater role in the presence of algae in the natural environment. It was concluded that the evaporation retardant Karmidol is nontoxic to the natural bacterioplankton under natural and laboratory conditions. Its presence stimulated the development of saprophytic bacteria. (Baker-FRD)
W81-05966

## 2E. Streamflow and Runoff

**STORM RUNOFF AS RELATED TO URBANIZATION IN THE PORTLAND, OREGON - VANCOUVER, WASHINGTON AREA,**
Geological Survey, Portland, OR. Water Resources Div.
For primary bibliographic entry see Field 4C.
W81-05713

**FLOOD OF APRIL 13, 1980, MOBILE, ALABAMA,**
Geological Survey, Louisville, KY. Water Resoaurces Div.
C. H. Hannum, and G. H. Nelson.
Geological Survey Open-File Report 80-1183, 1980. 6 Sheets.

Descriptors: *Flash floods, Data collections, *Rainfall, *Flood peak, Streamflow, Runoff, Historic floods, *Flood damage, Maps, Hydrographs, *Alabama, Mobile.

This report presents basic data collected during the flood of April 13, 1980, in Mobile, Alabama. The data consists of high-water marks, accumulative rainfall, peak discharge at local gaging stations, hydrographs of discharge and rainfall, and photographs at various locations taken during and immediately after the flood. The report presented in map-series and lists data that are readily usable by local planners and developers. During th afternoon of April 13, 1980, the National Weather Service at Mobile recorded a total of 10.4 inches of rainfall. Immediately after the flood approximately 60 to 70 percent of the roads in the Mobile area were impassable. (USGS)
W81-05717

**MULTIYEAR LOW FLOW OF STREAMS IN NORTHEASTERN KANSAS,**
Geological Survey, Lawrence, KS. Water Resources Div.
W. J. Carswell, Jr., and S. V. Bond.
Geological Survey Open-File Report 80-734 (WRI), 1980. 26 p, 15 Fig, 1 Tab, 5 Ref.

Descriptors: *Low flow, *Streamflow, *Water supply, *Water shortage, *Kansas, Water yield, Hydrologic data, Gaging stations, Sites, Drought, *Northeastern Kansas.

Many existing water supplies in northeastern Kansas are proving inadequate to meet current and expanded future needs. One of the methods by which the use of highly variable streamflow in the area can be evaluated is with the aid of multiyear low-flow frequency information. Using data form 19 streamflow-gaging stations in the study area, maps were developed from which the mean annual discharge and discharges for the 2- and 50-year recurrence interval for durations of 12,24, 36, 48, and 60 months can be obtained for rural ungaged sites that have drainage areas of less than 1,000 square miles. Discharges for intervening recurrence intervals can be obtained by interpolation. Extrapolation of regionalized discharges in this report to drainage areas smaller than about 50 square miles and larger than about 1,000 square miles has not been validated. (USGS)
W81-05719

**FLOOD OF AUGUST 31-SEPTEMBER 1, 1978, IN CROSSWICKS CREEK BASIN AND VICINITY, CENTRAL NEW JERSEY,**
Geological Survey, Trenton, NJ. Water Resources Div.
A. A. Vickers.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-221459, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-115, December, 1980. 20 p, 3 Fig, 3 Tab, 6 Ref.

Descriptors: *Floods, *Flood peak, Flood stages, *Flood profiles, Thunderstorms, Flood damage, Precipitation, Gaging stations, Indirect flood measurement, *Historic floods, *New Jersey, Crosswicks Creek basin.

A thunderstorm during the evening of August 31, 1978, caused flooding in a small area of south-central New Jersey. Maximum peaks of record occurred on the upper Crosswicks Creek basin in the vicinity of Fort Dix, Wrightstown, and New Egypt. At New Egypt, high water crest elevations for Crosswicks Creek were approximately 4 feet higher than the previous maximum recorded on August 28, 1971. Total damages were in excess of 2 million dollars, with 70 houses and 14 businesses affected. (USGS)
W81-05728

**CHARACTERIZATION OF FLOODFLOWS ALONG THE ARKANSAS RIVER WITHOUT REGULATION BY PUEBLO RESERVOIR, PORTLAND TO JOHN MARTIN RESERVOIR, SOUTHEASTERN COLORADO,**
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 4A.
W81-05730

**DEPTH ESTIMATION FOR ORDINARY HIGH WATER OF STREAMS IN THE MOBILE DISTRICT OF THE U.S. ARMY CORPS OF ENGINEERS, ALABAMA AND ADJACENT STATES,**
Geological Survey, University, AL. Water Resources Div.
J. R. Harkins, and M. E. Green.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $1.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-481, 1981. 12 p, 1 Fig, 3 Ref.

Descriptors: *Surface water, *Water depth, *Streamflow, *Flow duration, Natural flow, Natural streams, Drainage area, *Model studies, Regression analysis, *Alabama, Mobile, Estimating.

The 25 percent streamflow duration and corresponding depth were selected to represent ordinary high water. Statistical relations of 25 percent flow duration depth to eight basin parameters were analyzed using a stepwise linear regression procedure. A procedure for estimating 'ordinary high water' depth was derived using one independent variable--drainage area size. Two equations were derived; the standard error of estimate of the equation for hydrologic area 1, the Appalachian Plateaus, is 26 percent and for area 2, the Coastal Plains province, is 39 percent. The equations apply where the stream channels or streamflow is not significantly altered by man's activities. (USGS)
W81-05736

**MULTI-FACTOR ANALYSIS OF BANK CAVING ALONG A NAVIGABLE STREAM,**
For primary bibliographic entry see Field 2J.
W81-05752

**DESIGN DISCHARGE AS A RANDOM VARIABLE: A RISK STUDY,**
Montreal Univ. (Quebec).
For primary bibliographic entry see Field 6A.
W81-05821

**FILTERING OF PARTITIONED LARGE SCALE HYDROLOGICAL SYSTEMS,**
Princeton Univ., NJ, Dept. of Civil Engineering.
E. F. Wood.
Hydrological Sciences Bulltin, Vol 26, No 1, p 33-46, March, 1981. 7 Fig.

Descriptors: *Hydrologic systems, *River forecasting, *Flood forecasting, Watersheds, Filters, Mathematical models, Mathematical studies, Runoff.

A methodology is described which permits forecasting of large systems by partitioning the system into subsystems where the filtering of subsystems is performed in parallel. The noise processes are supplemented to acount for interactions between the partitioned subsystems. This partitioning overcomes the computational burden of implementing the Kalman filter in large hydrological systems. The partitioned approach was used in the River Dee in Wales and gave results which were virtually identical to those obtained from the Kalman filter for the whole basin. When using the partitioning system, each subsystem is identifiable and observable. The partitioning philosophy can be applied to other systems such as the state vector of the rainfall-runoff model by the uncertain state transition matrix elements. The augmented state vector is partitioned as described herein. The partitioning approach allows forecasting agencies to set up local forecast centers that are coordinated through a regional center. This is especially useful for large river basins which experience localized flooding in tributary streams. (Small-FRC)
W81-05832

**WRC STANDARD FLOOD FREQUENCY GUIDELINES,**
Susquehanna River Basin Commission, Harrisburg, PA.
D. R. Jackson.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 211-224, March, 1981. 2 Fig, 17 Ref.

Descriptors: *Flood frequency, *Standards, Statistical analysis, Hydrology, Susquehanna River Basin, Flood forecasting, Floods.

The Water Resources Council Bulltin 17 (guidelines for determining flood frequency at gaged locations) offers a significant contribution to the development of standard procedures for flood frequency analysis. Application of these guidelines in the Susquehanna River Basin revealed several problems. The optional regional skew coefficient map included in the Bulletin needs further development. A criterion for detecting high outliers is necessary. The criterion for determining low outliers needs modification, in particular, to prevent the inclusion in the analysis of peaks that are below the apparent lower bounds of the fitted log-Pearson Type III distribution. The procedure for weighting station and regional estimates should be evaluated more carefully, with particular attention to the effect of correlating the supposedly independent estimates and to the fit of the regional procedure to the station data. The principles underlying usage of the expected probability adjustment should be clarified and reasons for its use in particular situations agreed upon. Recommendations concerning use of the expected probability adjustment should be made more specific. (Cassar-FRC)
W81-05850

**REDUCING HYDROLOGIC PARAMETER UNCERTAINTY,**
Texas Univ. at Austin. Dept. of Civil Engineering.
Y-K. Tung, and L. W. Mays.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 245-262, March, 1981. 4 Tab, 26 Ref.

Descriptors: *Frequency analysis, *Parametric hydrology, *Hydrologic data, Statistical analysis, Streamflow, Rainfall, Flood frequency.

Parameter uncertainty in hydrologic frequency analysis can be reduced by a method which develops generalized values of the parameters (mean, standard deviation, and skewness) through the use of a weighting procedure between sample and regionalized statistics. Weights are defined as a function of the variances of the sample parameters and regionalized parameters. The variances of the sample parameters are determined using two nonparametric statistical methods, the jackknife and the bootstrap. The variances of the regionalized parameters are determined through regression analysis. The method is applied to flood prediction in five drainage basins in the Southwest U.S. (Cassar-FRC)
W81-05851

**'MAP SKEW'. (DISCUSSION),**
Illinois State Water Survey Div., Champaign.
K. P. Singh.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil engineers, Vol. 107, No. WRI, p 298-300, March, 1981. 1 Tab.

Descriptors: *Flood frequency, Statistical analysis, Hydrologic maps.

'Map Skew.' by McCuen (1979), concerning flood frequency analysis, presented an alternative contour map developed by assuming that the coefficient of skew varies with location parameters such as latitude and longitude. A comment on this work includes a method for modifying any perceivedoutliners so that fit the trend of the rest of the data. In this case, the skew increased after modification of outliers, the standard deviation decreased, the

mean increased, and the estimated of the 100-year flood increased 4.3-31.7%. (See W80-01026) (Cassar-FRC)
W81-05884

**STORMWATER DETENTION BASIN SIZING,**
MHM Inc., Marysville, CA.
K. R. Burton.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY3, p 437-439, March, 1980. 1 Fig.

Descriptors: *Storm water, *Water storage, *Detention reservoirs, Basins, Storm runoff, Pumping, Mathematical studies, Design criteria, Flow control.

A simple method is presented for estimating the required size of a stormwater detention basin. Detention basins are used to temporarily store storm runoff to avoid overloading of drainage facilities. To simplify sizing the basin, it is assumed that the pumping rate is constant, that stormwater enters the basin according to the idealized hydrograph for storm duration greater than concentration of watershed, and evaporation and percolation are ignored. Also, rainfall intensity is represented by a constant equation, and the rational method is sufficiently accurate for small watershed areas. Using the method, constants a and b are computed from rainfall records for the desired storm recurrence interval. Then, the watershed area and overall runoff coefficient are determined. A range of pumping rates is developed, and the combination of basin size and pumping rate that best fits the design requirements is selected. (Small-FRC)
W81-05895

**NEW ROUTING MODEL FOR CONTINUOUS RUNOFF SIMULATION,**
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2A.
W81-05899

**EVALUATION OF SHORT SERIES OF DISCHARGE MEASURMENTS BY MEANS OF LONG RECORDS OF WATER LEVEL AND RAINFALL (VALORISATION DE BREVES DUREES D'OBSERVATIONS DE DEBITS AU MOYEN DE LONGUES SERIES LIMNIMETRIQUES ET PLUVIOMETRIQUES),**
Montpellier-2 Univ. (France). Lab. d'Hydrologie Mathematique.
For primary bibliographic entry see Field 2A.
W81-05925

**TOTAL POLLUTION LOADS CONSIDERING URBAN STORM RUNOFF,**
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5B.
W81-05980

## 2F. Groundwater

**SURFICIAL GEOLOGY OF MALLORY QUADRANGLE, OSWEGO COUNTY, NEW YORK,**
Geological Survey, Albany, NY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05707

**MODEL OF THE GROUND-WATER FLOW SYSTEM OF THE GORDO AND EUTAW AQUIFERS IN WEST-CENTRAL ALABAMA,**
Geological Survey, University, AL. Water Resources Div.
R. A. Gardner.
Alabama Geological Survey Division of Water Resources Bulletin 118, 1981. 30 p, 25 Fig, 13 Tab, 30 Ref.

Descriptors: *Model studies, *Groundwater, *Artesian aquifers, *Potentiometric level, Geohydrology, Groundwater movement, Aquifer characteristics, Finite difference methods, Boundary conditions, *Alabama, Gordo aquifer, Eutaw aquifer.

Hydrologic conditions for a two-aquifer system consisting of the Gordo and Eutaw aquifers of Cretaceous age in west-central Alavama were simulated using a three-dimensional finite difference digital model. The model was calibrated to observed heads in the aquifers using a least squares method for obtaining the values for hydraulic parameters which provided the best fit to 28 calibration points in the model. The standard error of estimate for computed heads in the model is 3.46 feet. Data collected during the period 1900 to 1970 indicate that the modeled aquifer system is in a steady-state condition. The results of steady-state model simulations show that about 56 percent of the discharge from the system is by upward vertical leakage through confining beds to rivers, about 18 percent is to unregulated glowing wells, 10 percent is to pumped wells, and 16 percent is to boundaries. The areal distribution of water in the aquifer containing chloride concentrations greater than 1,000 milligrams per liter appears to be related to flow patterns in the system. Areas of greatest head loss in the system are those where there is natural discharge and pumpage. More than 80 percent of the head loss in the system can be attributed to natural discharge by upward leakage through the confining beds. (USGS)
W81-05714

**GROUND-WATER AVAILABILITY AND WATER QUALITY IN FRAMINGTON, CONNECTICUT,**
Geological Survey, Hartford, CT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05718

**GROUND-WATER LEVELS IN ALABAMA, FOR OBSERVATION WELLS MEASURED PERIODICALLY AUGUST 1952 THROUGH JULY 1977,**
Geological Survey, University, AL. Water Resources Div.
M. E. Davis.
Alabama Geological survey Division of Water Resources Circular 105, 1980. 74 p, 1 Fig, 2 Plates, 1 Tab, 17 Ref.

Descriptors: *Groundwater, *Water level, *Observation wells, *Data collections, Networks, sites, Groundwater availability, Water level fluctuations, Geohydrology, *Alabama.

The observation well network in Alabama was started in 1940. Unpublished water-level data collected periodically at 254 observation wells are listed in this report with the location, description, and general information on construction of the observation wells. Publications containing water-level data from selected observation wells are also listed. (USGS)
W81-05720

**TYPE CURVES FOR SELECTED PROBLEMS OF FLOW TO WELLS IN CONFINED AQUIFERS,**
Geological Survey, Lakewood, CO. Water Resources Div.
J. E. Reed.
Availabile from Br. of Dist., USGS, 1200 S. Eads St., Arlington, VA. 22202. Price $5.00. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter B3, 1980. 106 p, 37 Fig, 1 Plate, 17 Tab, 39 Ref.

Descriptors: *Groundwater, *Groundwater movement, *Wells, *Confined aquifers, Aquifer testing, Aquifer characteristics, Graphical analysis, Drawdown, Transmissivity, Storage coefficient, Leakage, Hydraulics, Unsteady flow, Hydrologic properties, Theis equation, Type-curve methods.

This report presents type curves and related material for 11 conditions of flow to wells in confined aquifers. These solutions, compiled from hydrologic literature, span an interval of time from Theis in 1935 to Papadopulos, Bredehoeft, and Cooper in 1973. Solutions are presented for constant drawdown, and variable discharge for pumping wells that fully penetrate leaky and nonleaky aquifers. Solutions for wells that partially penetrate leaky and nonleaky aquifers are included. Also, solutions are included for the effect of finite well radius and the sudden injection of a volume of water for nonleaky aquifers. Each problem summary includes the partial differential equation, boundary and initial conditions, and solutions. Programs in FORTRAN for calculating additional function values are included for most of the solutions. (USGS)
W81-05725

**ALLUVIAL AQUIFER OF THE CACHE AND ST. FRANCIS RIVER BASINS, NORTHEASTERN ARKANSAS,**
Geological Survey, Little Rock, AR. Water Resources Div.
M. E. Broom, and F. P. Lyford.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Paper copy $22.75, Microfiche $10.00. Geological Survey Open-File Report 81-476, 1981. 48 p, 4 Fig, 13 Plates, 5 Tab, 23 Ref.

Descriptors: *Alluvial aquifers, *Aquifer characteristics, *Geohydrologic units, Hydraulic conductivity, Groundwater movement, Well yields, irrigation, Pumping, Drawdown, Water level fluctuation, Water quality, Surface-groundwater relations, Mathematical models, Projections, Maps, *Arkansas, Cache River, St. Francis River.

The alluvial aquifer underlies about 9,000 square miles of the study area. Well yields from the aquifer commonly are from 1,000 to 2,000 gallons per minute. Flow toward the main area of pumping stress is eastward from the Cache River and westward from the St. Francis River. The Memphis aquifer acts as a conduit through Crowleys Ridge for induced flow from the St. Francis River basin to the Cache River basn. Water use from the alluvial aquifer since the early 1900's has been mostly for rice irrigation. Total pumpage for rice in 1978 was about 1,650,000 acre-feet, of which about 88 percent was pumped from the aquifer west of Crowleys Ridge. Water levels in wells west of the ridge in parts of Poinsett, Cross, and Craighead Counties in 1978 were 75 feet below land surface and declining about 2 feet per year. Digital-model analysis indicated that at the end of 1978 water was being removed from aquifer storage at the rate of 540,000 acre-feet per year, and streamflow, mostly from the Cache River and Bayou DeView, was being captured at the rate of 430,000 acre-feet per year. Projecting the 1978 pumping rate of 1,460,000 acre-feet per year, the pumping rate would have to be reduced by about 110,000 acre-feet per year by 1990 to sustain sufficient aquifer saturation for water needs through the year 2000 in all parts of Poinsett, Craighead, and Cross Counties west of Crowleys Ridge. (USGS)
W81-05726

**WATER-LEVEL CONTOURS NEAR LA GRANGE, SOUTHEASTERN WYOMING AND AN ADJACENT PART OF NEBRASKA, APRIL 30, 1980,**
Geological Survey, Cheyenne, WY. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05739

**GROUND WATER LEVEL CONTROL SYSTEM,**
Fox Pool Corp., York, PA. (Assignee).
C. C. Russell.
U.S. Patent No 4,227,266, 6 p, 6 Fig, 12 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 436. October 14, 1980.

Descriptors: *Patents, *Groundwater, *Water levels, Dewatering, Water table, Zone of saturation, Drainage engineering, *Swimming pools, *Damage control.

A system for controlling ground water level in a particular surrounding area is disclosed. In particu-

lar, a dewatering system to safeguard the integrity of an in-ground swimming pool against damage or disruption caused by excess water accumulating at or near the soil surrounding the swimming pool is described. Such contiguous ground water, when it rises to an undesirably high level, for example, such as at a level higher than the level of water in a swimming pool, as a consequence of the resulting hydrostatic pressure, will cause adverse effects. The invention provides a system for the removal of ground water accumulating in a given area in excess of a predetermined level until the desired level is restored. A receptable or container containing porous walls is placed at a suitable location contiguous to the pool and below the surface of the ground. A pump removes accumulated water from the container. (Sinha-OEIS)
W81-05797

**VERIFICATION OF THE POTENTIAL YIELD OF THE SHALLOW DOLOMITE AQUIFER IN DUPAGE COUNTY, ILLINOIS,**
Illinois State Water Survey Div., Champaign.
R. T. Sasman, R. J. Schicht, C. R. Benson, and R. S. Ludwigs.
SWS Contract Report No 239, October, 1980. 24 p, 12 Fig, 2 Tab, 6 Ref.

Descriptors: *Aquifer management, *Dolomite, *Urban watersheds, Water level recorders, Pumpage, Water supply, Water table decline, Optimal yield, Diversion losses, Bedrock, Available water, Water level fluctuations, Data collections, *Groundwater availability, *Chicago area, Illinois, *Potential water supply.

The shallow dolomite aquifer in DuPage County, Illinois, is an important source of water for the Chicago metropolitan region and an alternative to using Lake Michigan water. A detailed data collection program was conducted over a 700-square-mile area to analyze the effects of continually increasing pumpage, to identify existing and potential problem areas, and to identify areas where additional pumpage can be developed. Shallow aquifer pumpage in the study area increased 92 percent during the period 1966-1978 and was 61.7 mgd in 1978, of which 57.3 mgd was from the dolomite. Pumpage in DuPage County increased 91 percent during the same period. The 1978 pumpage of 45.8 mgd was 103 percent of the potential yield. Water levels have lowered considerably as a result of the continual increase in pumpage throughout much of the area. In DuPage County, water levels in the shallow dolomite declined more than 10 feet over an area of 98.4 square miles during the period 1966-1979. Water levels were lowered below the bedrock surface over approximately 9.5 square miles of DuPage County since 1966. An average of 27.6 feet of rock has been dewatered over this area. A volume of 7.3 billion cubic feet of dolomite and 3.3 billion cubic feet of sand and gravel has been dewatered in DuPage County during 1966-1979. If pumpage in the year 2000 is in the same ratio as in 1978, shallow aquifer pumpage will be approximately 18 mgd more than the potential yield of these aquifers. Extremely severe dewatering over extensive areas would result and most wells/well fields would have major decreases in yields. (Garrison-Omniplan)
W81-05800

**SIMULATION OF A COMPLEX GROUNDWATER SYSTEM AND AN APPLICATION,**
Asian Inst. of Tech., Bangkok (Thailand).
J. Premchitt, and A. D. Gupta.
Water Resources Research, Vol 17, No 3, p 673-685, June, 1981. 15 Fig, 2 Tab, 30 Ref.

Descriptors: *Subsidence, *Pumping, *Groundwater level, Model studies, Mathematical models, Deep wells, *Thailand, Aquifers, Groundwater depletion.

A simplified and practical model of an extensive groundwater basin was developed to study land subsidence caused by deep well pumping in Bangkok, Thailand. Borehole data, geologic interpretation, and field measurements were used to establish a realistic model. This is a quasi-three-dimensional flow model in which the subsurface body is considered as a single, hydraulically connected body. Concepts of aquifer and aquitard are discarded. The layered system creates high permeability in the horizontal direction and very low permeability in the vertical direction. Pumping can be imposed at any depth, and discharge rates can be arbitrary. The model proved flexible in a simulation of the groundwater flow regime in the Lower Central Plan of Thailand for a 45-year period. Calibration was done with data from 1959-1979, and groundwater levels were predicted with an annual increase of 5% in pumping. Levels will sink from 40-50 ft below the surface in 1980 to 80-100 ft in the year 2000. (Cassar-FRC)
W81-05805

**PRECONSOLIDATION STRESS OF AQUIFER SYSTEMS IN AREAS OF INDUCED LAND SUBSIDENCE,**
Geological Survey, Menlo Park, CA.
T. L. Holzer.
Water Resources Research, Vol. 17, No. 3, p 693-704, June, 1981. 13 Fig, 2 Tab, 40 Ref.

Descriptors: *Subsidence, *Groundwater level, *Aquifer systems, Water level, Compacted soils, consolidation sedimentation, Stress, Unconsolidated aquifers, Preconsolidation stress.

Aquifer systems in Arizona (Eloy-Picacho), Texas (Houston-Galveston), and California (Tulare-Wasco and Santa clara Valley) appear to have been overconsolidatedby 1.6-6.2 bars (16-63 meters of water) before man began groundwater withdrawl from these areas. The relation of land subsidence as measured by bench mark levels to water level decline is bilinear, depicted in two linear segments. The substance per unit water level decline remained constant until water levels had declined 16-63 meters, at which point the subsidence per unit water level decline increased to larger constant values. This is believed to be evidence for natural overconsolidation of the compacting part of the aquifer system. Areas with linear conditions are Bowie, Arizona, and Las Vegas Valley, Nevada. Here land subsidence per unit water level decline has remained nearly constant. the water level decline at which the ratio of subsidence to unit water level decline changed is the amount by which the preconsolidation stress exceeded the overburden stress on the aquifer system that existed prior to groundwater withdrawals. (Cassar - FRC)
W81-05810

**DETERMINATION OF HORIZONTAL-TO-VERTICAL HYDRAULIC CONDUCTIVITY RATIOS FROM SEEPAGE MEASUREMENTS ON LAKE BEDS,**
Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Lab.
V. K. Barwell, and D. R. Lee.
Water Resources Research, Vol 17, No 3, p 565-570, June, 1981. 3 Fig, 4 Tab, 26 Ref.

Descriptors: *Anisotropy, *Seepage, *Hydraulic conductivity, *Lake beds, Model studies, Aquifer characteristics, Groundwater movement.

A new method for determining anisotropy of aquifers contiguous with lakes is based on the observed rate of decline of seepage flux with distance offshore and on the aquifer thickness. Deviation from an exponential decline in seepage rate with distance offshore gives a measure of aquifer heterogeneity and consequently an estimate of the reliability of the determination. Anisotropy ratios are calculated from field measurements of seepage fluxes through lake beds and several boreholes. A salt tracer study performed on Perch Lake at Chalk River and Lake Sallie, Minnesota, produced seepage measurements which were used in the equation with good results. The formula cannot be used in very narrow lakes, in shallow aquifers with a high anisotropy ratio, or in a nonuniform aquifer. However, for suitable situations, the method is inexpensive and rapid. (Cassar-FRC)
W81-05812

**CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: ANALYTICAL SOLUTION FOR A SINGLE FRACTURE,**
Princeton Univ., NJ.
D. E. Tang, E. O. Frind, and E. A. Sudicky.
Water Resources Research, Vol 17, No 3, p 555-564, June, 1981. 10 Fig, 12 Ref.

Descriptors: *Solute transport, *Porous media, *Geologic fractures, *Path of pollutants, Radioactive wastes, Groundwater contamination.

A general analytical solution is developed for the problem of contaminant transport along a discrete fracture in a porous rock matrix. The solution considers advective transport in the fracture, longitudinal mechanical dispersion in the fracture, molecular diffusion in the fracture fluid along the fracture axis, molecular diffusion from the fracture into the matrix, adsorption on the face of the matrix, adsorption within the matrix, and radioactive decay. The problem is formulated as two coupled, one-dimensional partial differential equations: one for the fracture and one for the porous matrix in a direction perpendicular to the fracture. Comparison of this solution with a simpler solution which assumes negligible longitudinal dispersion in the fracture shows considerable error in the simpler solution at lower ranges of groundwater velocities. Another comparison with a numerical solution shows excellent agreement under conditions of large diffusive loss. This situation resembles the problem of transport in discretely fractured rocks, lending support to the formulation developed in this paper. (Cassar-FRC)
W81-05813

**LABORATORY MEASUREMENTS OF THE STRONTIUM DISTRIBUTION COEFFICIENT KDSR FOR SEDIMENTS FROM A SHALLOW SAND AQUIFER,**
Queen's Univ., Kingston (Ontario). Dept. of Geological Sciences.
For primary bibliographic entry see Field 5B.
W81-05819

**COSEISMIC CHANGES IN GROUNDWATER TEMPERATURE OF THE USU VOLCANIC REGION,**
Hokkaids Univ., Sapporo (Japan). Geophysical Inst.
For primary bibliographic entry see Field 1A.
W81-05843

**GROUND WATER IN DIAGENETICALLY CONSOLIDATED ROCKS AND ITS INDIRECT RECONNAISSANCE BY AIRPHOTO LINEAR ANALYSIS,**
Mainz Univ. (Germany, F.R.). Inst. fuer Geowissenschaften.
For primary bibliographic entry see Field 7B.
W81-05945

**STOCHASTIC MODELS OF SUBSURFACE FLOW: INFINITE VERSUS FINITE DOMAINS AND STATIONARITY,**
New Mexico Inst. of Mining and Technology, Socorro.
For primary bibliographic entry see Field 2G.
W81-05951

**A SIMILARITY METHOD FOR GEOTHERMAL WELL TEST ANALYSIS,**
California Univ., Berkeley. Berkeley Lawrence Lab.
M. J. O'Sullivan.
Water Resources Research, Vol 17, No 2, p 390-398, April, 1981. 11 Fig, 6 Tab, 19 Ref.

Descriptors: *Geothermal studies, *Test wells, *Flow rates, Flow discharge, Flow pattern, Flow measurement, Discharge coefficient, Flow characteristics, Hydrodynamics, Geophysics.

The main advance achieved in the analysis presented is the recognition that the constant flow rate well test problem for any geothermal flow, whether liquid, two-phase, flashing, or superheated

steam, can be formulated in terms of equations which admit a similarity variable, even when all nonlinearities in the governing equation are included. Once this is accomplished, the solution procedure is straightforward, and results for a wide range of problems can be quickly obtained. The accuracy of the solution method provides a means of checking the results obtained by using standard reservoir simulation methods, so that they can be used with confidence for analyzing constant flow rate well test results and other well test results such as buildup tests and multiple flow rate tests for which the similarity method does not perform adequately. The simplicity of the similarity method enables lengthy calculations to be made very quickly, and therefore it provides a useful tool for parameter testing and for using field data to investigate theoretical problems such as the form of the relative permeability functions. (Baker-FRC)
W81-05953

**AGE DATING OF GROUNDWATER IN FISSURED ROCK: INFLUENCE OF WATER VOLUME IN MICROPORES,**
California Univ., Berkeley. Berkeley Lawrence Lab.
I. Neretnieks.
Water Resources Research, Vol 17, No 2, p 421-422, April, 1981. 7 Ref.

Descriptors: *Groundwater dating, *Fissure water, Water, Geologic fractures, Dating, *Radioactive dating.

This short communication suggests that there may be a large difference between the residence time of groundwater in fissures and the actual age of the water. The residence time of the water is the ratio of the volume of the water-bearing fissures to the volumetric flow rate of the water. Small molecules such as carbonate ions or water molecules with a tritium atom have access to the micropores of the rock matrix by diffusion but not by flow. Thus the residence time of individual molecules will be longer than the residence time of the flowing water. Available data indicate that the diffusivity of small molecules and ions in the water-filled microfissures of granite matrices is of the order of some percent to some tens of percent of the diffusivity in unconfiend water. Such a diffusivity will allow a considerable amount of the water in the micropore volume of the rock matrix to be reached by the diffusion species. Under these circumstances the retention time of flowing water in the fissures in the rock will be very much smaller than that of C-14 atoms which have access to the micropore volume of the rock as well. (Baker-FRC)
W81-05954

**MASS TRANSPORT. 2. ANALYSIS OF UNCERTAINTY IN PREDICTION,**
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 5B.
W81-05998

## 2G. Water In Soils

**IMPROVED LINEAR TRIAL FUNCTION FINITE ELEMENT MODEL OF SOIL MOISTURE TRANSPORT,**
California Univ., Irvine. School of Engineering.
T. V. Hromadka, II, and G. L. Guymon.
Water Resources Research, Vol. 17, No. 3, p 504-512, June, 1981. 4 Tab, 9 Ref.

Descriptors: *Soil moisture, *Approximation method, Mathematical studies, Model studies, *Finite element method, Infiltration, Soil moisture transport.

Two techniques for modeling a higher order approximation function of soil moisture transport using an improved linear trial function approximation are presented. The first approach is based upon use of the alternation theorem and a finite element capacitance matrix that incorporates the Galerkin finite element, subdomain, finite difference, and proposed nodal domain integration methods. The second approach builds on the first by developing a temporal relationship for element matrices so that a higher-order approximation function can be modeled by a linear approximation function. This numerical approach may lead to a generalized modeling method for all soil moisture transport problems. (Cassar - FRC)
W81-05808

**COMPARISON OF WATER ADSORPTION BY MONOVALENT EXCHANGE ION FORMS OF SOIL HUMIC MATERIAL AND SYNTHETIC EXCHANGES,**
Florida Univ., Gainesville. Dept. of Soil Science.
For primary bibliographic entry see Field 2K.
W81-05838

**FINITE DIFFERENCE CALCULATION OF UNSATURATED PERMEABILITY,**
Rutgers - The State Univ., New Brunswich, NJ. Dept. of Soils and Crops.
W. J. Busscher.
Soil Science, Vol 131, No 4, p 210-214, April, 1981. 6 Fig, 10 Ref.

Descriptors: *Permeability, *Aeration zone, *Soil water, Mathematical models, Mathematical equations, Soil saturation, Finite difference methods, Unsaturated flow, Hydraulic conductivity.

The unsaturated hydraulic conductivity of soils is difficult and time-consuming to measure. As a result, there has been considerable interest in the possibility of calculating it on the basis of other soil properties. The procedure presented in this paper uses a finite differencing technique to approximate a single-phase, one-dimensional flow equation and solve for unsaturated permeability in a drying soil. The effect of other terms of the equation on the value of permeability was determined through a sensitivity analysis. Permeability values were calculated for large time intervals of flow, using steady-state and time-varying equations. Differences of permeability ranging from 3 to 130 percent were found between steady-state and non-steady-state calculations for the given time term. Overestimation of the time term led to larger errors than did underestimation. Sensitivity analyses indicated that potential gradient errors were slightly more significant for the steady-state case, while flow errors were more significant for the time-varying case. Overestimation of potential gradient was found to lead to smaller errors than underestimation. Permeability was affected by uniform changes in potential, primarily through changes in potential gradient. (Carroll-FRC)
W81-05840

**EFFECTS OF PLOWING DEPTH AND DEEP INCORPORATION OF LIME AND PHOSPHORUS UPON PHYSICAL AND CHEMICAL PROPERTIES OF TWO COASTAL PLAIN SOILS AFTER 15 YEARS,**
North Carolina State Univ. at Raleigh. Dept. of Soil Science.
D. K. Cassel.
Soil Science Society of America Journal, Vol 44, No 1, p 89-95, January/February, 1980. 5 Fig, 4 Tab, 15 Ref.

Descriptors: *Soils, *Chemical properties, *Physical properties, Agriculture, Agricultural hydrology, *Lime, *Phosphorus, Fertilizers, Permeability coefficient, Infiltration, Percolation, Soil moisture, Available water, *Plowing depth effects.

Long-term effects of deep plowing on selected soil physical and chemical properties of two Atlantic Coastal Plain soils are discussed. One of the soils was Norfolk sandy loam; the other was Wakulla loamy sand. Selected soil properties were examined 15 years after the installation of various depth-of-plowing treatments. The soils initially had tillage-induced pans and low subsoil pH. The Norfolk sandy loam was plowed in 1960 to depths of 18, 38, and 56 cm, and Wakulla loamy sand was plowed to depths of 18 and 56 cm. Specified amounts of dolomitic limestone and phosphorus were applied during and prior to the plowing operation. As plowing depth increased, soil strength increased and infiltration rate decreased, creating physical conditions more unfavorable for root growth. The incorporation of P and lime by deep plowing increased the levels of P, Mg, and Ca in the 18- to 38- and 38- to 51-cm depths making chemical conditions more favorable for rooting. Deep plowing increased the hydraulic conductivity at the 0- to 18- to 38-cm depths at higher soil water pressures primarily due to higher volumetric soil water contents which resulted from higher bulk densities and finer textured material in the soil matrix. (Baker-FRC)
W81-05915

**NITRATE MOVEMENT UNDER CORN AND FALLOW CONDITIONS,**
Auburn Univ., AL. Dept. of Agronomy and Soils.
F. L. Long, and M. G. Huck.
Soil Science Society of America Journal, Vol 44, No 4, p 787-792. July/August, 1980. 6 Fig, 2 Tab, 15 Ref.

Descriptors: *Nitrates, *Corn, *Leaching, Fertilizers, Agricultural chemicals, Nitrogen compounds, Solubility, *Solute transport, Ion transport, Ions.

A study was performed to assess the movement of nitrogen applied to corn growing under atmospheric conditions in a rhizotron with more intensive measurements than could be obtained in the field. The soil was Dothan loamy sand. Nitrogen was applied at 250 and 500 kg N/ha. The nitrate movement was monitored by analysis of soil solution samples taken at 48 to 72 hr intervals over 120 days from the 20, 40, 60, 80, 100, and 140-cm depths. Nearly all nitrate applied to the surface of fallow plots moved with percolating water and was leached below the 100-cm depth within 65 days. This was true for both application rates of nitrogen. Actively growing corn roots intercepted nitrate from the 250 kg N/ha treatment before it reached the 80 cm depth and from the 500 kg treatment before it reached the 100-cm depth. At maturity the above-ground portion of the corn contained 20% more N than was applied at the 250 kg rate and 75% of that applied at the 500 kg rate. Corn roots effectively prevented leaching of nitrate. (Baker-FRC)
W81-05916

**COTTON YIELD AND NUTRIENT UPTAKE IN RELATION TO WATER TABLE DEPTH,**
Science and Education Administration, Brawley, CA. Imperial Valley Conservation Research Center.
B. D. Meek, E. C. Owen-Bartlett, L. H. Stolzy, and C. K. Labanauskas.
Soil Science Society of America Journal, Vol 44, No 2, p 301-305, March/April, 1980. 2 fig, 4 Tab, 27 Ref.

Descriptors: *Nutrients, *Crop production, Water table, *Soil aeration, Oxygen balance, Soil water, Oxygen uptake, Cotton, Agriculture, Conductance, Osmotic pressure, *Soil-water-plant relationships.

The objectives of this study were to determine the effect of various water table depths on soil aeration, to determine the effect of water table on plant water relations, and to measure nutrient uptake and stem, leaf, and seed cotton yields at harvest. The experiments were conducted on clayey over loamy soils, of the montmorillonitic hyperthermic family of Typic Torrifluvents. The soil pH was 7.8, with a cation exchange capacity of about 24 meq/100 g and organic matter content of about 1%. Three subsurface drains were installed in the area. Cotton was planted in April 1976, with seed spaced at 15 to 20 cm in rows spaced 102 cm apart. Salinity increased from an initial range of 2.5 to 2.9 mmho/cm to 9.7, 7.7, and 4.8 mmho/cm at the end of the experiment for the 30-, 60-, and 90-cm water table depths, respectively. The optimum water table depth was 90 cm or greater, with reductions in seed cotton yield of 43 and 25% for water table depths of 30 and 60 cm, respectively. As water table depth increased from 30 to 90 cm, concentrations in stems and leaves of N, Ca, K, and Cu increased, whereas concentrations of P, Mg, Na, B, and Cl decreased. Increasing the

water-table depth increased the total uptake of all elements studied. When the water-table depth was increased from 30 to 90 cm, soil aeration status increased considerably, as measured by soil oxygen content, redox potential, and oxygen diffusion rate. (Baker-FRC)
W81-05917

**STOCHASTIC MODELS OF SUBSURFACE FLOW: INFINITE VERSUS FINITE DOMAINS AND STATIONARITY,**
New Mexico Inst. of Mining and Technology, Socorro.
A. L. Gutjahr, and L. W. Gelhar.
Water Resources Research, Vol 17, No 2, p 337-350, April, 1981. 10 Fig, 16 Ref.

Descriptors: *Storm seepage, *Stochastic process, Model studies, Mathematical studies, Probabilistic process, Flow, Flow measurement, Porous media, Soil porosity, Porosity, Capillary water, *Groundwater movement.

Several techniques are used to develop stochastic solutions of the differential equation describing one-dimensional flow through a porous medium with spatially variable hydraulic conductivity which is represented by a stationary random process. The analytical approximations using first-order analysis, covariance differential equations, and variogram analysis all yield consistent results which demonstrate the important effects of boundary conditions and conditioning. Using the theory of intrinsic random functions, stochastic solutions are developed for the case when the logarithm of the hydraulic conductivity is a three-dimensional stationary random field. In contrast to the one-dimensional case, it was found that the resulting three-dimensional head perturbation will be locally stationary under very general conditions. Results from the one-dimensional analytical solutions are found to be in agreement with previous Monte Carlo simulations for a flow system of finite length. The solution based on linearization in the logarithm of hydraulic conductivity proved to be very robust, showing reasonable agreement with Monte Carlo results even for the largest input standard deviation. (Baker-FRC)
W81-05951

**THE INFILTRATION-SOIL WATER STORAGE RELATIONSHIP AT A POINT IN WATERSHED MODELING,**
Control Data Australia Party Ltd., North Sydney, New South Wales.
For primary bibliographic entry see Field 2A.
W81-05994

**A DERIVATION OF THE MACROSCOPIC SOLUTE TRANSPORT EQUATION FOR HOMOGENEOUS, SATURATED, POROUS MEDIA. 2. REACTIVE SOLUTES AT LOW CONCENTRATION,**
California Univ., Riverside. Dept. of Physics.
S-Y. Chu, and G. Sposito.
Water Resources Research, Vol 17, No 2, p 333-336, April, 1981. 13 Ref.

Descriptors: *Solutes, *Adsorption, Porous media, Capillary water, Soil porosity, Porosity, Molecular structure, Kinetics, *Solute transport, Saturated flow, Equations.

The principal objective of this paper is to establish a foundational theory of reactive solute transport in homogeneous, saturated, porous media. A brief review is offered of the macroscopic transport equation for an adsorbing solute, which delineates clearly the role played by mass balance in both the liquid and the solid phases in relation to models of adsorptive behavior. This review is followed by the development of the cumulant expansion approach, including a detailed consideration of the molecular-kinetic picture of adsorption. A macroscopic transport equation is derived for a solute at low concentration which interacts with a solid matrix. For the uniform case where there is only one type of adsorption site on the solid matrix, the resulting expression is identical in form with the standard dispersion convection equation incorporating a first-order kinetic adsorption model. For the more general case in which there is more than one type of adsorption site, the difference between the transport equation derived here and the standard dispersion-convection equation is discussed. (Baker-FRC)
W81-05999

**INFLUENCE OF ENVIRONMENTAL FACTORS UPON THE LEACHING OF CATIONS FROM UNDISTURBED MICROCOSMS OF BEECH AND SPRUCE LITTERS,**
Liege Univ. (Belgium). Dept. of Botany.
P. Buldgen, and J. Remacle.
Soil Biology and Biochemistry, Vol 13, No 2, p 143-147, 1981. 2 Fig, 5 Tab, 21 Ref.

Descriptors: *Leaching, *Cations, *Forests, Trees, Beech trees, Spruce trees, Sodium, Potassium, Calcium, Magnesium, Rainfall, Temperature, Decomposing organic matter, Soil mechanics.

Leaching processes occurring in the holorganic horizons of an anthropic forest were compared with those occurring in a beech forest in order to evaluate the impact of the forest types on the nutrient balance and the influence of environmental factors upon the leaching processes. The leaching of four nutrient cations from undisturbed beech and spruce litters was evaluated in relation to five environmental factors: nature of the organic layers, temperature, quality of rain, rainfall, and stage of humus development. Temperature, quality of rain, type of humus, and time of sampling (age of humus) were found to have the most effect on leaching rate. The cation leaching rates were greatest for sodium, followed by potassium, magnesium, and calcium, in that order, independent of environmental factors. The study results show that plant cover controls the fate of nutrients directly by supplying the humus material and indirectly by determining the characteristics of such environmental factors as throughfall rain and temperature. (Carroll-FRC)
W81-06036

## 2H. Lakes

**MEASUREMENT OF VISIBLE RADIATION TRANSFER IN WATER UNDER LABORATORY AND FIELD CONDITIONS,**
Purdue Univ., Lafayette, IN. School of Mechanical Engineering.
F. P. Incropera.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108481, Price codes: A05 in paper copy, A01 in microfiche. Water Resources Research Center, Purdue University Technical Report No 140, September, 1981. 81 p, 36 Fig, 4 Tab, 17 Ref. OWRT A-058-IND(2).

Descriptors: *Solar radiation, *Distribution patterns, *Natural waters, *On-site-tests, *Laboratory tests, Albedo, Irradiation, Field tests, Radiation trasfer, *Heat transfer, Thermal radiation, Surface waters.

Solar radiation transfer in a body of water strongly influences thermal conditions and the growth of photosynthetic organisms, thus there has been considerable interest in the development of methods for accurately predicting this transfer. The objectives of the study were (1) to measure the optical properties of natural waters, (2) to measure the distribution of radiation of water samples under laboratory conditions and to compare the results with predictions, and (3) to measure the distribution of radiation under field conditions. Working with samples of water from the Wabash River, a complete set of optical property measurements were obtained. For these river water samples, measurements of the angular and depth distribution of the radiation were made under laboratory conditions for which the directional distribution of the incident radiation were approximately isotropic. The measurements were compared with predictions based on the discrete ordinate and three-flux theoretical methods. In addition, angular and depth distributions of the radiation were obtained under field conditions. The distributions were strongly influenced by radiation scattering from the collimated beam, with the depth distribution being characterized by a maximum below the air-water interface and the directional distribution exhibiting a maximum in the direction of the collimated beam. (Wiersma-IND)
W81-05704

**STUDIES OF THE EFFECTS OF OPERATING THE MT. ELBERT PUMPED-STORAGE POWERPLANT ON TWIN LAKES, COLORADO: 1979 REPORT OF FINDINGS,**
Water and Power Resources Services, Denver, CO. Engineering and Research Center.
J. F. LaBounty, J. J. Sartoris, S. G. Campbell, J. R. Boehmke, and R. A. Roline.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-240483, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-80-7, December, 1980. 70 p, 29 Fig, 7 Tab, 29 Ref, Append.

Descriptors: *Preoperational studies, *Limnology, *Twin Lakes, Colorado, *Powerplants, Phytoplankton, Zooplankton, Water temperature, Hydrogen ion concentration, Nutrients, Specific conductivity, Primary productivity, Dissolved oxygen, *Baseline studies.

A series of studies is being performed to qualify and quantify the changes that occur to the limnological features of Twin Lakes because of the Mt. Elbert Pumped-Storage Powerplant, scheduled to begin operation in 1981. Twin Lakes are a pair of dimictic, connected, montane, drainage lakes of glacial origin. This report presents the results of studies done during 1979. These results, along with those from other studies done since 1971 when the project began, are being used to define the preoperational limnology of Twin Lakes. Maximum water temperature recorded at Twin Lakes during 1979 was 16.4C on the surface of the lower lake in August. The lowest dissolved oxygen concentration was 1.3 mg/l near the bottom of the lower lake in April. pH ranged from 6.3 to 8.6, while conductivity levels were always between 42 and 122 micro S/cm. Total phosphorus and nitrate-nitrogen concentrations averaged 1.8 and 46.0 microgram/l, respectively. Primary productivity rates ranged from 99 to 21,696 microgram carbon/sq m per h. Chlorophyll a concentrations averaged about 3 mg/cm m for all depths and all sampling dates. The phytoplankton was predominantly Dinobryon, Asterionella, Synedra, and Dictyosphaerium. Besides being significantly lower in abundance, phytoplankton in the upper lake is dominated by Asterionella and Synedra. The zooplankton population was dominated by two species of copepods, three species of rotifers, and mysis shrimp. Large pelagic cladocerons are notably absent from Twin Lakes. The benthos of Twin Lakes is dominated by chironomids, oligochaetes, and fingernail clams, averaging 2023, 524, and 0/sq m, respectively. Fingernail clams are only rarely found in the upper lake.
W81-05743

**MODIFICATIONS OF MODELS PREDICTING TROPHIC STATE OF LAKES: ADJUSTMENT OF MODELS TO ACCOUNT FOR THE BIOLOGICAL MANIFESTATIONS OF NUTRIENTS,**
Environmental Monitoring Systems Lab., Las Vegas, NV.
For primary bibliographic entry see Field 5C.
W81-05778

**PHOSPHORUS RETENTION MODELS FOR TENNESSEE VALLEY AUTHORITY RESERVOIRS,**
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.
J. M. Higgins, and B. R. Kim.
Water Resources Research, Vol. 17, No. 3, p 571-576, June, 1981. 6 Fig, 3 Tab, 8 Ref.

Descriptors: *Phosphorus compounds, *Reservoirs, *Water quality, Tennessee Valley authority, Lakes, Model studies, Lake morphometry, Settling velocity, Retention time, Fate of pollutants, Plug flow reactor model, Phosphorus retention models.

Data on phosphorus inflow and outflow for 18 large Tennessee Valley Authority (TVA) reservoirs were compared with continuous stirred tank reactor models (CSTR) for predicting steady state P concentration in lakes. A plug flow reactor model (PFT) is presented for lakes which have a wide variation in P concentations from inflow to outflow. This model is characteristic of reservoirs, which usually have a larger length to width ratio than most lakes. Results indicate that P sedimentation and retention coefficients developed for most lakes cannot be directly applied to TVA reservoirs. The apparent settling velocity in the 10 TVA reservoirs with positive P retention and P inflow concentrations of less than 0.025 mg per liter was 92 meters per year for the CSTR models and 61 meters per year for the PFR model. Application of the plug flow model to the Cherokee Reservoir agreed well with measured P concentrations. (Cassar - FRC)
W81-05807

**BIOCHEMICAL OXYGEN DEMAND-DISSOLVED OXYGEN MATHEMATICAL MODELLING IN DEEP RESERVOIRS WITH MODIFIED WATER QUALITY FOR RIVER-RESERVOIR SYSTEMS MODEL,**
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering.
L. D. Spraggs.
Canadian Journal of Civil Engineering, Vol 8, No 1, p 59-62, March, 1981. 3 Fig, 3 Ref.

Descriptors: *Dissolved oxygen, *Biological oxygen demand, *Deep water, *Reservoirs, Lakes, Model studies, Mathematical models, Oxygen, Detritus, Nutrients, Boundary Reservoir, Saskatchewan.

The WQRRS one-dimensional mathematical model for predicting dissolved oxygen at the bottom of deep reservoirs produced too-rapid depletions in oxygen. Analysis of the model showed that it could be improved by maintaining the traditional BOD-dissolved oxygen and detritus-nutrient relatioships but removng the oxygen demand from the detrital decay. This modification was tested on Boundary Reservoir, Saskatchewan, in May-October, 1975. Although the bottom oxygen is overestimated in this test, seasonal trends are clearly indicated. With more input data, dissolved oxygen simulation can be improved. (Cassar-RFC)
W81-05873

**DISTRIBUTION OF ZOOPLANKTON POPULATIONS WITHIN AND ADJACENT TO A THERMAL PLUME,**
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 5C.
W81-05874

**EMPIRICAL RELATIONSHIPS BETWEEN PHYTOPLANKTON AND ZOOPLANKTON BIOMASS IN LAKES,**
McGill Univ., Montreal (Quebec). Dept. of Biology.
E. McCauley, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 4, p 458-463, April, 1981. 3 Fig, 2 Tab, 39 Ref.

Descriptors: *Zooplankton, *Phytoplankton, *Biomass, *Lakes, Model studies, Regression analysis, Crustaceans, Aquatic life, Invertebrates.

Crustacean zooplankton biomass was predicted from measures of phytoplankton biomass using empirical models based on regression analysis of published plankton biomasses in lakes. Zooplankton biomass is positively related to phytoplankton biomass. As the ratio of zooplankton to phytoplankton biomass decreases, phytoplankton biomass increases. A possible cause for the variation in the biomass of the crustaceans is the variation in biomass of nannoplankton, the principal food source for crustaceans in the community. (Cassar-FRC)
W81-05875

**LONG-TERM REPLACEMENT CYCLES IN CLADOCERAN COMMUNITIES: A HISTORY OF PREDATION,**
Dartmouth Coll., Hanover, NH. Dept. of Biological Sciences.
W. C. Kerfoot.
Ecology, Vol 62, No 1, p 216-233, February, 1981. 14 Fig, 6 Tab, 64 Ref.

Descriptors: *Predation, *Replacement, *Waterfleas, Cladocerans, Invertebrates, Aquatic animals, Fish, Succession, Seasonal variation, Bosmina, Zooplankton, Frains Lake, *Michigan, Sediments, Lakes, Lake sediments, Fossils, Eutrophication, Eutrophic lakes.

Populations of the waterflea Bosmina were studied in water and sediments of Frains Lake, a 6.7 ha eutrophic lake in Michigan. The present population, as in many modern lakes, features an abundance of long-featured clones in winter and short-featured clones in summer. The short-featured forms are superior competitors and come to dominate when fish remove or depress the predatory copepods. Long-featured forms are favored in the presence of a large predatory copepod population. In sediments of 14,000 years BP both Bosmina fossils and predatory copepods were abundant, as judged by the injuries on Bosmina parts. At about 9,800 years BP copepods were reduced and Bosmina shifted toward moderate lengths. After forest clearance and abrupt elimination of larger cladocerans, Bosmina increased greatly in number and became shorter. Eutrophication occurred at this time. Evidence suggests that the changing balance between planktonivorous fishes and predatory copepods, rather than temperature or trophic state, is responsible for changes in phenotypes. (Cassar-FRC)
W81-05879

**WATER QUALITY IN STANDING-WATER PONDS FOR WINTER PRODUCTION OF RAINBOW TROUT IN ALABAMA,**
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
For primary bibliographic entry see Field 8I.
W81-05912

**MYSIS RELICTA: EFFECTS OF TURBIDITY AND TURBULENCE ON SHORT-TERM SURVIVAL,**
Colorado Cooperative Fishery Research Unit, Fort Collins.
For primary bibliographic entry see Field 5C.
W81-05923

**STOCHASTIC SIMULATION OF TEMPERATURE EFFECTS ON FIRST-YEAR SURVIVAL OF SMALLMOUTH BASS,**
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W81-05930

**DIEL PATTERNS OF REPRODUCTION IN ROTIFER POPULATIONS FROM A TROPICAL LAKE,**
Colorado Univ., Boulder. Dept. of Environmental, Population and Organismic Biology.
J. F. Saunders, III.
Freshwater Biology, Vol 10, No 1, p 35-39, February, 1980. 2 Fig, 13 Ref.

Descriptors: *Lakes, *Rotifers, Population dynamics, Aquatic animals, Tropical regions, Plankton, Population density, Valencia Lake, *Venezuela.

The possibility of diel reproductive periodicity in the major rotifer populations of Keratella americana Carlin, Brachionus havanaensis Rousselet, and B. calyciflorus Pallas was investigated in populations taken from Lake Valencia, Venezuela. Lake Valencia is a large endorheic lake that lies in north central Venezuela. The planktonic rotifer fauna is not diverse, and brachionids are typically dominant. Population densities of these brachionids are high during the period of seasonal circulation. Collections were made during January and February. Preliminary studies of egg development times provided the first indication of diel hatching periodicity in the lake. The entire body of results indicated that significant diel variation can occur in both egg deposition and eclosion. For Keratella americana, both variables were marked by significant nonuniformity. For B. havanaensis, egg deposition rates were significantly non-uniform, but egg eclosion rates were not. Both variables showed similar diel patterns of variation, so it is possible that the time intervals chosen provided insufficient resolution for detecting nonuniformity in egg eclosion rates. The results of B. calyciflorus studies were somewhat less clear. The existence of non-random reproduction has practical ramifications for studies of population dynamics and secondary production. (Baker-FRC)
W81-05944

**ULTRA-TRACE ANALYSIS OF SOLUBLE ZINC, CADMIUM, COPPER AND LEAD IN WINDERMERE LAKE WATER USING ANODIC STRIPPING VOLTAMMETRY AND ATOMIC ABSORPTION SPECTROSCOPY,**
Freshwater Biological Association, Windermere (England).
W. Davison.
Freshwater Biology, Vol 10, No 3, p 223-227, June, 1980. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Lakes, *Trace metals, Metals, Zinc, Cadmium, Lead, Copper, *Windermere Lake, *England, Atomic absorption spectroscopy, Spectroscopy.

Windermere is a moderately productive softwater lake of the English Lake District. There is very little industry in its catchment area. Major sources of trace metals are air-borne and cultural. Sedimentary trace metal content has increased markedly over the values recorded in the early nineteenth century, and a new constant trace metal sedimentation rate has been established. All lakewater samples were collected near a buoy located at the deepest part of the North Basin of Windermere. The concentrations of trace metals in filtered and unfiltered lake water were measured using anodic stripping voltammetry (with and without digestion by ultraviolet irradiation), and by atomic absorption spectroscopy with electrothermal atomization. Total soluble components in micrograms per liter were estimated to be: zinc, 2.1; cadmium 0.05; lead, less than 0.1;, and copper, 0.3. Atomic absorption spectrophotometric results and ultraviolet digested, anodic stripping voltammetric results were in good agreement. All measurable zinc was electrochemically labile, whereas copper above the detection limit of 0.09 micrograms per liter was electrochemically inert. (Baker-FRC)
W81-05971

**THE EFFECT OF SEWAGE EFFLUENT ON DENITRIFICATION IN GRASMERE (ENGLISH LAKE DISTRICT),**
Freshwater Biological Association, Cumbria (England).
J. G. Jones, M. T. Downes, and I. B. Talling.
Freshwater Biology, Vol 10, No 4, p 341-359, August, 1980. 14 Fig, 4 Tab, 44 Ref.

Descriptors: *Lakes, *Denitrification, Nitrogen removal, Wastewater disposal, *Effluents, Sewage, Bacteria, Nitrogen, Seasonal variation, Grasmere Lake, England.

Various techniques were used to study the denitrification processes active in Grasmere Lake. Nitrate reductase activity was measured in sediments, and the accumulation of nitrogenous gases in samples was also noted. Measurements were made of changes in the concentration of inorganic nitrogen species in water columns and the release of gas bubbles into gas traps suspended above the sediment. Sewage effluent enters the lake via the main inflow. Fecal bacteria were used as tracers to map the path of the river and the effluent across the lake. An island lies in the center of the lake; the main river flow was west of this island and across the smaller of the two main basins. This western basin was the site of most active denitrification. A seasonal survey demonstrated that deoxygenation,

nitrate reduction and ammonium accumulation were more advanced at this site. In this area consistent discharge of nitrogen and methane from the profundal zone was noted. The sediment was the major site of denitrification, and the activity in the water column was higher in the anoxic hypolimnion than in the euphotic zone. Maximum denitrifying activity occurred below the mud level in the oxidized sediments. A bimodal seasonal pattern of nitrate reductase activity was noted at four sites during thermal stratification. The major denitrification site was identified, and it was calculated that the nitrogen gas discharged was equivalent to about 54% of the nitrate removed from the water column. (Baker-FRC)
W81-05972

**SWAMP FORMATION IN THE LITTORAL ZONE OF RESERVOIRS,**
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
M. N. Dekhtyar.
Hydrobiological Journal, Vol 16, No 1, p 7-11, 1980. 14 Ref.

Descriptors: *Reservoirs, *Swamps, *Littoral environment, Littoral zone, Intertidal areas, Zones, Aquatic life, Storage reservoirs, Trophic level, *Swamp formation.

During 1971-1974, a study was made of the formation of a swamp in the littoral zone of Kremenchung reservoir. During this time the biomass of the microzoophytes declined from 1.7 to 0.4 g per kg wet weight of the plants. This sharp reduction was correlated with an increase in the specific abundance of Rhizopoda and Testacea. Reasons determined for the fairly rapid formation of swamps in the shallows of this particular reservoir include the vast biomass of vegetation produced in the littoral zone of the reservoir, the predominance of aerial-aquatic water plants in the vegetation due in large measure to the operational regime of the reservoir, and the conditions under which vegetation decomposes, largely determined by the water level regime of the reservoir. More than half of the area of the shallows is uncovered in the autumn-winter, so that the coarse vegetation does not decompose during the winter. Its decomposition commences in the spring, when the bank zone is inundated and about 50% of the reed biomass decays during the summer. Consideration must also be given to the negative role of aerial-aquatic plants in the oxygen balance of a water body. (Baker-FRC)
W81-05974

**MERCURY ACCUMULATION IN AND GROWTH RATE OF RAINBOW TROUT, SALMO GAIRDNERI, STOCKED IN AN EASTERN OREGON RESERVOIR,**
Oregon State Univ., Corvallis. Dept. of Agricultural Chemistry.
For primary bibliographic entry see Field 5B.
W81-05975

**ESTIMATION OF BACKGROUND LOADINGS AND CONCENTRATIONS OF PHOSPHORUS FOR LAKES IN THE PUGET SOUND REGION, WASHINGTON,**
Geological Survey, Seattle, WA.
R. J. Gilliom.
Water Resources Research, Vol 17, No 2, p 410-420, April, 1981. 6 Fig, 3 Tab, 40 Ref.

Descriptors: *Lakes, *Phosphorus, Estimating, *Nutrients, Chemical composition, Estimating, Water, Puget Sound area, Eutrophication, Washington, Mass balance model.

A method is presented for estimating background phosphorus (P) concentrations in lakes of the Puget Sound lowland. This steady state, mass balance model proved successful in estimating P loading of a lake. Loading rates so calculated are empirical estimates of loading that are dependent on the type of the P concentration measurement used. Loading was calculated from the summertime total-P concentration in the epilimnion. P loading can be quickly evaluated for many lakes in a region with a minimum of data. These rates can aid in developing sample empirical relations between loadings and P sources. Annual P yield from forested areas in the study region was found to have a high positive correlation with annual runoff. Failure to account for this relationship would yield unreliable predictions. Empirical relations developed allow predictions of background P loadings of lakes in the area studied with acceptable reliability. These estimates can be used in combination with the mass balance lake model to calculate background P concentrations in the lake. In lakes with development in their drainage basins, estimated background P can be compared to measured epilimnion P to estimate the impact of the development on the lake water. There is a disadvantage to this method in that the empirically derived P-loading rates cannot be directly measured to verify calculations and are not directly equatable with measured loadings of defined chemical species of P. However, total-P loading can be approximated to provide a value for comparison to measured loadings by increasing empirically derived loading by 17%. (Baker-FRC)
W81-05993

**CONTRIBUTION OF HYPOLIMNETIC WATER ON METALIMNETIC DISSOLVED OXYGEN MINIMA IN A RESERVOIR,**
Ouachita Baptist Univ., Arkadelphia, AR. Dept. of Chemistry.
J. Nix.
Water Resources Research, Vol 17, No 2, p 329-332, April, 1981. 4 Fig, 10 Ref.

Descriptors: *Hypolimnion, *Reservoirs, Lakes, *Dissolved oxygen, Thermal stratification, Oxygen, Residual oxygen.

During the stratified period in numerous lakes and reservoirs a minimum in the dissolved oxygen distribution has been noted to develop in the metalimnion. In most cases this minimum is explained by the accumulation of organic matter from the overlying layer of water. The introduction of organic matter from the interflow of storm water may also be a likely contributor to the accelerated oxygen depletion within the metalimnion. Even during low flow periods, water containing reduced species in the deeper upstream section of DeGray Reservoir, Arkansas, is being incorporated into a density current and transported advectively through the metalimnetic region. It is suggested that this mechanism may contribute significantly to the development of metalimnetic dissolved oxygen minima in the reservoirs with similar stratification and flow characteristics to the DeGray Reservoir. (Baker-FRC)
W81-05995

**EARTHQUAKE-DAMMED LAKES IN NEW ZEALAND,**
Department of Energy, Mines, and Resources, Ottawa (Ontario). Earth Physics Branch.
J. Adams.
Geology, Vol 9, No 5, p 215-219, May, 1981. 3 Fig, 2 Tab, 30 Ref.

Descriptors: *Earthquakes, *Lake classification, *New Zealand, Lake morphology, Lakes, Seismology, Geophysics, Dams, Landslides.

Landslides in New Zealand, many of which are triggered by earthquakes, produce both temporary and permanent lakes. Most earthquake-triggered landslides consist of rock avalanches or rock falls which create lakes which are soon filled with sediment. About 30 landslide-dammed lakes in New Zealand can be considered permanent because they either formed in prehistoric times or have an expected life of several hundred years. Summary data are presented for 38 landslide-dammed lakes in New Zealand, and detailed descriptions of five of these lakes are presented. The following five lakes are described in detail: Lake Stanley, Lake Chalice, Lake Waikaremoana, Lake Matiri, and Lake Christabel. A smooth ellipse that just contains the landslide-dammed lakes of a single age is an indication of an area shaken to Modified Mercalli (mm) intensity X. By relating earthquake magnitude to the extent of the area shaken to MM intensity X, the size of a past earthquake can be estimated. The 1929 Buller earthquake resulted in the creation of 11 small lakes in New Zealand. Four other lakes are known to have been created by earthquakes, and a group of nine additional lakes were probably formed by prehistoric earthquakes. It is suggested that a group of eight of these prehistoric lakes may have been formed by an earthquake having a magnitude of about 7.4 in about 1650 A.D. Careful identification of groups of landslide-dammed lakes could provide a conservative estimate of paleoseismicity for the past few hundred or thousand years without reliance on the identification of an active fault. (Carroll-FRC)
W81-06001

**EARLY COMPOSITION AND BIOMASS OF THE CRUSTACEAN ZOOPLANKTON IN BOUGH BEECH RESERVOIR, SOUTH-EAST ENGLAND,**
Chelsea Coll., London (England). Dept. of Zoology.
I. G. Munro, and R. G. Bailey.
Freshwater Biology, Vol 10, No 1, p 85-96, February, 1980. 3 Fig, 3 Tab, 45 Ref.

Descriptors: *Reservoirs, *Zooplankton, Eutrophication, Nutrients, Nitrogen, Phosphorus, Benthic environment, Biomass, Seasonal variation.

Bough Beech is a euthrophic reservoir, and throughout the period of this study the levels of nitrate-nitrogen and orthophosphate at the end of the winter were in excess of the levels suggested as being likely to lead to the development of algal blooms. The recorded silicate levels were also always greater than the limiting value for diatom growth. Winter impoundment of water from the River Eden ensures an annual replenishment of nutrients. It is suggested as probable that, after the initial filling of the river, input was augmented by nutrient releases from the reservoir basin. A total of eight crustaceans was identified in the open water during this study. At any given time the zooplankton population was comprised of one or two cladoceran and two or three copepod species, of which the cladocerans were generally numerically predominant. Marked changes in the zooplankton community occurred in the first two years of the study and were related to changes in predation pressure by fishes. By the end of the third year, the composition of the zooplankton community had stabilized. The cladoceran biomass was normally in excess of that of the copepods, with maxima in spring and autumn. Peaks in copepod biomass occurred within two months of those of the Cladocera. (Baker-FRC)
W81-06002

**PHYTOPLANKTON ECOLOGY IN AN ANTARCTIC LAKE,**
British Antarctic Survey, Cambridge (England).
J. J. Light, J. C. Ellis-Evans, and J. Priddle.
Freshwater Biology, Vol 11, No 1, p 11-26, 1981. 9 Fig, 2 Tab, 61 Ref.

Descriptors: *Phytoplankton, *Antarctic, *Iced lakes, Lakes, Eutrophic lakes, Plankton, Benthic flora, Seasonal variation, Polar regions, Heywood Lake, Algae, Carbon radioisotopes, Chlorophyll.

Heywood Lake, on Signy Island in the South Orkney Islands, Antarctica, is a moderately eutrophic lake which is frozen to a maximum depth of 1 meter for between 8 and 10 months each year. The vegetation is dominantly phytoplankton, and benthic plants are found only in the shallow water areas. Elephant seals swim in the lake during its ice-free period, enriching the water with their excreta. The ecology of the phytoplakton in the lake was investigated during the period 1969 through 1972. Very few algal cells were detected in the water column during the winter months, and carbon-14 fixation was below measurable limits. Large increases in the chlorophyll-a concentration in the spring months were caused by a rapidly-growing algae populaton. However, carbon-14 levels remained below 500 milligrams per meter per day. The algae contributing to this peak were mostly small chlorophytes and chrysophytes. Crytophytes dominated the phytoplankton populations during the summer open-water season. While chlo-

rophyll levels were lower, carbon-14 fixation rates greater tha 3 grams per meter per day were measured on bright days. The ratio of carbon-14 production to chlorophyll concentration was very high for the lake's summer phytoplankton. In autumn, the phytoplankton regressed to winter levels. The summer and spring algal populations probably exist in resting stages during the autumn and winter months. (Carroll-FRC)
W81-06005

**THE PRODUCTIVITY OF PISTIA STRATIOTES L. IN A EUTROPHIC LAKE,**
Ibadan Univ. (Nigeria). Dept. of Botany.
B. M. Sharma, and M. K. C. Sridhar.
Environmental Pollution, (Series A), Vol 24, No 4, p 277-289, 1981. 1 Fig, 9 Tab, 16 Ref.

Descriptors: *Eutrophic lakes, *Aquatic weeds, *Aquatic productivity, Aquatic plants, Weeds, Lakes, Organic wastes, Biological oxygen demand, Phosphorus, Ammonia compounds, Biomass, Africa, Aquaculture, Nigeria.

Pistia stratiotes L. is a free-floating perennial aquatic weed which is common in most of the water bodies in Nigeria which receive organic pollution. Previously available data on the weed was limited to information on occurrence, physiology of growth and respiration, elemental composition, and control measures using various herbicides. This study used a combination of field and laboratory work to investigate the occurrence and growth characteristics of the weed in Nigerian natural water bodies affected by organic pollution and the potential use of the weed as a feed supplement for animals. The growth of Pistia stratiotes L. was more virgorous in the highly polluted zone of the eutrophic lake studies than in the less polluted zone. The plant has a high water content of about 94 percent. The weed has been harvested by mechanical means for use as compost and was at one time used for human food during periods of famine. As it grows in eutrophic lakes and other water bodies, the weed removes both organic and mineral pollutants, including removal of about 83 percent of the biological oxygen demand, 93 percent of the ammonia nitrogen, and 75 percent the phosphorus. The plant, which prevents evaporation losses of water by about 20 percent, also conserves solar energy and synthesizes about 14 percent protein. While the decomposing plant may contribute to the eutrophication of water bodies if it is not harvested, the rate of pollutant removal is faster than the contribution by decomposition. (Carroll-FRC)
W81-06007

**STUDIES ON THE BOTTOM DEPOSITS OF LAKE BROLLUS, A DELTA EGYPTIAN LAKE,**
Alexandria Univ. (Egypt). Dept. of Oceanography.
M. A. H. Saad.
Cahiers ORSTOM, Serre Hydrobiologie, Vol 13, No 3/ 4, p 181-185, 1979/80. 1 Fig, 2 Tab, 14 Ref.

Descriptors: *Lake sediments, *Physicochemical properties, *Deltas, *Egypt, Physical properties, Chemical properties, Mud, Sediments, Bottom sediments, Lake Brollus.

Various physico-chemical studies were made of sediment samples collected from Lake Brollus, a large shallow brackish-water delta lake located in the northern part of the Nile delta in Egypt and connected to the Mediterranean Sea. The lake receives both sea water and huge amounts of drainage waters from the surrounding agricultural lands. This study was designed to collect information on the nature and composition of the surface sediments of the lake in an effort to learn more about the lake's fertility. The lake bottom varies from sandy mixed with silty materials near the lake-sea connection to muddy black at the southern end of the lake. The density of wet muds from the lake ranged from 1.55 to 1.21 grams per cubic centimeters, while the water contents fluctuated between 76 and 45 percent. Inverse relationships were generally found between the density of wet mud and the water content and between the amounts of water and allochthonous materials in the mud. The variation of water in the sediments was due mainly to the nature and type of the sediment. The dry materials in the sediments from the western half of the lake were considerably heavier than those from the eastern half. The percentages ranged from 55 to 24 percent. The dry matter weight differences resulted from the variable components of the muds from diverse lake areas, particularly the organic matter, the calcareous substances, the allochthonous materials, and the diatom-silica contents. The amounts of each of these components deposited on one square meter of wet mud showed considerable variation, with organic matter ranging from 1.6 to 0.5 kilograms, calcareous substances ranging from 4.5 to 1.1 kilograms, allochthonous materials varying from 3.65 to 1.17 kilograms, and diatom-silica fluctuating from 70 to 20 grams per square meter. The quantitative distribution of these components in the sediment samples was influenced by the drainage received from the agricultural lands, sand carried from dunes to the north of the lake by prevailing winds, the presence of calcareous shells, and the distribution of diatom frustules. (Carroll-FRC)
W81-06012

**THE VEGETATION OF THE TUZDA RESERVOIR AND ITS PRODUCTION,**
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. B. Korsak, and V. K. Myakushko.
Hydrobiological Journal, Vol 16, No 1, p 22-27, 1980. 1 Tab, 17 Ref.

Descriptors: *Reservoirs, *Vegetation, Plant growth, Environmental effects, Water bodies, *Tuzda Reservoir, Russia.

The main plant coenoses of the shallows, the species concerned, the structure, ecological characteristics and distribution of vegetation are reported following a two year study at the Tuzda reservoir, on the Irtysh-Karaganda canal. The reservoir was created in 1970 in the valley of the Tuzda River, a small river that dries up in the summer and has water with a high content of dissolved salts that is unsuitable for drinking. The upper reaches of the Tuzda are heavily polluted owing to the heavy development of livestock farming and irrigated agriculture and form a source of biogenic and organic matter entering the reservoir. In terms of the primary production of the reservoir, the main plant resources were concentrated in the shallows at the head of the reservoir and in the bays. Annual production of macrophytes was 2240 tons of organic matter. Figures calculated for the production of macrophytes were about three times as high as comparable figures for other water bodies, including the Kiev and Kremenchug reservoirs on the Dnieper, more than twenty times the plant production of Rybinsk, Gor'kiy and Volgograd reservoirs on the Volga, but only 1/5 of the production of macrophytes in similar reservoirs on the Karakum canal. (Baker-FRC)
W81-06017

**THE MICROZOOBENTHOS OF THREE LAKES OF DIFFERENT TYPES,**
Belorussian State Univ., Minsk (USSR).
V. A. Babitskiy.
Hydrobiological Journal, Vol 16, No 1, p 27-34, 1980. 2 Fig, 4 Tab, 32 Ref.

Descriptors: *Lakes, *Benthos, Microorganisms, Aquatic life, Benthic fauna, Benthic flora, Biomass, Lake Naroch, Lake Myastro, Lake Batorin, Eutrophic lakes, Eutrophication, Trophic level, Russia.

The microzoobenthos of three lakes in the Narochan group was investigated. Samples were taken at various depths and from various bottom materials over a period of two years. The bulk of the microbenthic animals was concentrated in the upper 2-5 cm zone of bottom material. Testacea are significant components of the microbenthos, inferior in numbers only to benthic infusorians. In all the lakes the largest number of species of microbenthic animals was found in sands, silted to varying degrees. The nucleus of the psammophilous assemblage consisted of Nematoda, Oligochaeta, Cladocera, Copepoda and Chironomid larvae. The biomass quantity peaked in June-July and in September through November. The overall abundance of the microbenthos was 127 times that of the macrobenthos in Lake Naroch and as high as 2,200 times in Lake Myastro, while the biomass of the microbenthos was 15% that of the microbenthos in Lake Naroch, but around 100% in Lake Myastro and 44% in Lake Batorin. (Baker-FRC)
W81-06018

**CHARACTERISTICS AND CLASSIFICATION OF THE LAKES OF SIGNY ISLAND, SOUTH ORKNEY ISLANDS, ANTARCTICA,**
British Antarctic Survey, Cambridge (England).
R. B. Heywood, H. J. G. Dartnall, and J. Priddle.
Freshwater Biology, Vol 10, No 4, p 47-59, February, 1980. 4 Fig, 9 Tab, 33 Ref.

Descriptors: *Lakes, *Eutrophication, *Antarctica, Polar regions, Signy Island, Benthic environment, Monitoring, *Lake classification, Classification, Statistical analysis.

This paper presents a multivariate statistical analysis of data obtained from studies of the lakes of Signy Island, in the South Orkney Islands, Antarctica. Current relationships between the lakes were studied to produce a baseline and create a classification scheme for the various lake types. It was felt that in this manner feedback could be obtained, which would aid in revising the monitoring program to ensure that the important variables were being examined. Water samples were collected in midsummer and during the period of maximum ice thickness. The majority of benthic plant samples were collected during scuba-diving surveys. Invertebrates were collected by a simple suction sampler. Particular attention was given to the development and composition of the phytoplankton and the benthic algal communities, which are taken to be integrators of the lakes' nutrient status and light climate. To test the value of the biological indicators, the vegetation types and the Alona-Branchinecta data were superimposed on the three-dimensional plot of the factor scores. A simple classification based on both Principal Components Analysis (PCA) and biological results is presented. (Baker-FRC)
W81-06019

**TEMPORAL AND VERTICAL DISTRIBUTION OF CILIPHORAN COMMUNITIES IN THE BENTHOS OF A SMALL EUTROPHIC LOCH WITH PARTICULAR REFERENCE TO THE REDOX PROFILE,**
Stirling Univ. (Scotland). Dept. of Biology.
B. J. Finlay.
Freshwater Biology, Vol 10, No 1, p 15-34, February, 1980. 9 Fig, 3 Tab, 37 Ref.

Descriptors: *Benthos, *Eutrophication, Lakes, Protozoa, Sediments, Organic matter, Decomposing organic matter, Microbial degradation, Temperature, Organic carbon, Light intensity, *Scotland.

A small, shallow, eutrophic loch located in Scotland was sampled. Three benthic sites were sampled over a two year period. Particular attention was given to the pattern of vertical distribution within the sediment and the temporal distribution of ciliates occurring in the surface sediment. Multiple regression was used to analyze the relationships between ciliate distributions and the environmental factors. Significant relationships were revealed between vertical distribution of ciliates and the sediment redox profile. Larger ciliate communities were associated with regions of higher potential. Sediment density, organic matter, temperature and daylight were selected in the regression analysis as accounting for much of the variation in the depth distribution of ciliates. Day length, temperature, organic carbon and benthic chlorophyll-a were significant factors in determining the variation in ciliate numbers. Large increases in number and biomass of surface-sediment ciliates in the summer months resulted from an intolerance of the reducing conditions developing immediately beneath the surface and the increased productivity of the benthos as a whole during this period. Methods are described for constructing, calibrating and operat-

ing electrodes used in measuring various parameters relating to freshwater benthos. (Baker-FRC)
W81-06020

**A LIMNOLOGICAL SURVEY OF LAKE DAKATAUA, A LARGE CALDERA LAKE ON WEST NEW BRITAIN, PAPUA NEW GUINEA, WITH COMPARISONS TO LAKE WISDOM, A YOUNGER NEARBY CALDERA LAKE,**
Australian National Univ., Canberra City. Dept. of Neurobiology.
E. Ball, and J. Glucksman.
Freshwater Biology, Vol 10, No 1, p 73-74, February, 1980. 4 Fig, 4 Tab, 8 Ref.

Descriptors: *Lakes, *Limnology, Lake morphology, Lake stages, Thermocline, Thermal stratification, Acidity, Alkalinity, Chemical properties, Aquatic plants, Invertebrates, Comparison studies, Papua New Guinea.

A limnological survey was made of Lake Dakataua, which is a large freshwater lake filling a caldera at the tip of the Willaumez Peninsula of West New Britain, Papua New Guinea. The peninsula was produced by post-collapse volcanic activity, and it divides the lake into two basins connected through a narrow channel. At the time of sampling in October-November 1974 the lake was alkaline, with a surface pH of 7.6-8.2. With depth, acidity was found to increase, to a pH of 7.1-7.5. Temperatures on the surface were 30.8 to 31.9C. Thermoclines existed at 22 meters and at 40-45 meters. No measurable oxygen was detected from 80 meters downward. Dredge hauls to 20 meters revealed that living organisms were common. None were found, however, in deeper samples. The concentration of carbon dioxide rose steadily from 1.4 mg/liter at the surface to 19.6 mg/liter at 80 meters depth. The average Secchi disc transparency was 11.1 meters. Dense beds of mixed aquatic plants were found in the shallow water areas. Two species of sponge, a rotifer, an ostracod, six species of molluscs, seven species of Caldocera, a copepod, eight species of Hemiptera, two species of Trichoptera ten species of Odonata, two species of Coleoptera, and seven species of Chironomidae were among the invertebrates collected. Vertebrates included frogs and crocodiles. Water birds were abundant. (Baker-FRC)
W81-06021

**FURTHER STUDIES ON THE PALAEOLIMNOLOGY AND CHANGES IN THE PHOSPHORUS BUDGET OF BARTON BROAD, NORFOLK,**
University of East Anglia, Norwich (England). School of Environmental Sciences.
B. Moss.
Freshwater Biology, Vol 10, No 3, p 261-279. June, 1980. 11 Fig, 4 Tab, 21 Ref.

Descriptors: *Lakes, *Paleolimnology, Limnology, *Phosphorus, Aquatic plants, Sulfides, *Sediments, Eutrophication, Sediment transport, Peat bogs, Peat soils, Peat, Organic soils, Wastewater disposal, Agriculture, Barton Broad, Norfolk, England.

Sediment core samples were taken from Barton Broad, a man-made lake in Norfolk created by peat excavation prior to the fifteenth century. The cores fell into two groups. In the first at least the surface 27 cm was very dark brown, grading to black at the surface. In the second group the upper layer was brown or dark beige. In all cores the darker surface layers were underlain by grey-brown marl, the transition between the layers covering about 5 cm. Under the marl layers and sometimes mixed with them for long transition zones was a chocolate-colored finely divided peaty marl, and below this, and very distinct, the fibrous basin peat. It was determined from examination of the samples that during the first 400 years the broad must have had a very sparse plankton population and only a moderate development of macrophytes and benthic algae. From at least 1730, the broad had essentially its present configuration and relationship to the river. During the 19th century it underwent a first burst of increasing productivity, shown by the increasing deposition of bottom-living and epiphytic diatoms, dry matter and phosphorus. This coincided with the first stages of more intensive agriculture in the broadland valleys. Agriculture, including land drainage, produced a lake with increased aquatic plant growth yet still negligible plankton populations, culminating in the very extensive aquatic plant populations of the mid-20th century. A striking horizontal pattern has been noted, consisting of a long black tongue of sulfide-rich sediment extending into the broad from the inflow river. (Baker-FRC)
W81-06022

**THE THERMAL, OXYGEN AND LIGHT REGIMES IN ISOLATED COLUMNS OF WATER IN A TURBID IMPOUNDMENT,**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Botany.
A. J. Twinch, and C. M. Breen.
Freshwater Biology, Vol 10, No 3, p 207-213, June, 1980. 3 Fig, 20 Ref.

Descriptors: *Reservoirs, *Physical properties, *Nutrients, *Phosphorus, Turbidity, Temperature, Thermal stratification, Oxygen balance, Dissolved oxygen, Oxygen, Light penetration, Opacity, Benthic environment, Algae, Eutrophication.

The objective of this paper was to describe the thermal, oxygen and light regimes within isolated water columns to determine if they were likely to markedly influence the exchange of nutrients, particularly phosphorus. Four isolation columns were used during the study, positioned at a depth of about four meters, and each enclosing a volume of about 68,000 liters. The water overlies terrestrial soil that was drowned after the construction of Midmar Dam during 1964-66, with a thin surface covering of 1-5 cm of recently deposited material. The study was conducted over a continuous period of 13 months, between April 1976 and June 1977. In general the thermal conditions between the adjacent open water and the columns was slight. Oxygen levels in bottom waters in the enriched columns were slightly lower than in the open water, but never dropped below 50% saturation. It seems unlikely that sufficient depletion occurred to markedly increase release of phosphorus from the sediment. Light penetration in the columns was more varied than in the open water but was seldom sufficient to permit the development of large stands of benthic algae. (Baker-FRC)
W81-06023

**DISTRIBUTION OF AQUATIC OLIGOCHAETA IN THE FINNISH LAKE DISTRICT,**
Jyvaskylae Univ. (Finland). Dept. of Biology.
J. Sarkka, and J. Aho.
Freshwater Biology, Vol 10, No 3, p 197-206. June, 1980. 1 Fig, 6 Tab, 17 Ref.

Descriptors: *Lakes, *Aquatic life, Eutrophication, *Oligotrophic lakes, Eutrophic lakes, Oligotrophy, Trophic level, Oligochaetes, Tubificids, Annelids, *Finland, Worms.

Variations in the distribution and abundance of oligochaete worms, especially as a function of the varying degrees of eutrophication and pollution, were investigated in the southern drainage basin of the river Kokemaenjoki in Finland. The drainage basin is situated at the boundary of eutrophic and oligotrophic lake type areas and also at the boundary of two main economic areas of Finland. Sampling stations were divided into three types: eutrophic and dystrophic areas or areas polluted by pulp-mill wastewaters; slightly eutrophic stations; and clean stations unaffected by sewage or other inputs. In the eutrophic and dystrophic group areas Limnodrilus hoffmeisteri and Potamothrix hammoniensis were practically the only species present. These same species accounted for two thirds of the total numbers in group 2, although Peloscolex ferox and some other species also occurred. At the clean stations, P. ferox, Psammoryctides barbatus, Stylodrilus heringianus and Tubifex tubifex were the dominant species. Factor analysis demonstrated that L. hoffmeisteri and P. hammoniensis were associated with increases in nutrients and water color in the lower part of the epilimnion. In the metalimnion the relationship of S. heringianus and P. ferox to water color and total nitrogen differed from that of L. hoffmeisteri and P. hammoniensis. Winter oxygen content was important for S. heringianus. (Baker-FRC)
W81-06024

**ASSOCIATIONS OF BENTHIC ANIMALS IN SOME OF THE WATER BODIES OF THE DNIEPER-SOZH INTERFLUVE,**
Gomel State Univ. (USSR).
I. P. Arabina, and N. N. Shalovenkov.
Hydrobiological Journal, Vol 16, No 1, p 71, 1980.

Descriptors: *Canals, *Benthos, Water bodies, Aquatic life, Biomass, Dnieper-Sozh interfluve, Agriculture, Land use, Drainage canals, Drainage ditches, Drainage programs, Population density.

The formation of benthic associations was investigated in manmade water bodies in the Dnieper-Sozh interfluve, and the trophic structure and energy balance of these associations was also studied. Samples were taken in July of 1975 in Lake Tuchnoye and in two of the main canals of the Dnieper land improvement system. The entire benthic population in one of the canals was encompassed in a single Viviparus viviparus biocenosis, in wich 43 species of hydrobionts were found. Five food groupings were recorded. The main energy flow was through the food-gathering detritophages and filter feeders. Three biocenoses were distinguished in the area of land improvement of the other canal. Thirteen species of hydrobionts were recorded. The dominant species were ingesting mud eaters and predators. Two biocenoses were found in the littoral zone of Lake Tuchnoye. The water sources of the canals played a key role in the formation of benthic populations of drainage works. The distribution of associations and of hydrobionts over the canal bed was primarily dependent on flow rate, bottom material and depth. Nearly 50% of the energy in the benthic association passed through the population of the dominant species, while 85-96% passed through the dominant food groupings. (Baker-FRC)
W81-06025

**THE NATURAL LIFE OF THE LITTORAL ZONE OF A RESERVOIR AND ITS EFFECT ON THE PELAGIC ZONE (WITH REFERENCE TO THE BACTERIOPLANKTON AND ZOOPLANKTON OF IVAN'KOVO RESERVOIR),**
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. N. Stolbunova, and A. K. Stolbunov.
Hydrobiological Journal, Vol 16, No 1, p 1-6. 1980. 5 Tab, 11 Ref.

Descriptors: *Reservoirs, *Aquatic life, Littoral zone, Intertidal areas, Zones, Littoral environment, Pelagic zone, Plankton, Zooplankton, Bacteria, *Ivan Kovo Reservoir, Russia.

During the years 1973-1975 attempts were made to assess the extent to which the allochthonous and autochthonous organic matter of the littoral zone of Ivan'kovo reservoir affected the open areas of the reservoir directly, by the change in its content and in the rate of destruction, and through the dynamics of the abundance and structure of the bacterioplankton and zooplankton. Consideration was also given to the food relationships between bacteria and zooplankton organisms. It was determined that the effects of the biogenic elements and organic matter of the littoral zone on the eutrophication of the pelagic zone are dependent on the amounts reaching the pelagic zone. The mineralizing activity of the bacterioplankton and the zooplankton determined the excess of organic matter that was not mineralized in the littoral zone, but did enter the pelagic zone and supplemented the reserves of biogenic elements in the water body. (Baker-FRC)
W81-06028

**NEW WATER TREATMENT PACKAGE AT MERY-SUR-OISE, IN THE VICINITY OF PARIS, A STORAGE RESERVOIR (LA NOUVELLE FILIERE DE TRAITEMENT DE L'EAU POTABLE A MERY-SUR-OISE, PRES DE PARIS: LE BASSIN DE STORAGE),**

Compagnie Generale des Eaux, Paris (France).
O. Pascal.
Aqua, No 3, p 3-7, 1980. 4 Fig.

Descriptors: *Water storage, *Reservoir storage, Potable water, Mery-sur-Oise, *France, Self-purification, Water quality, Storage, Water treatment facilities, *Water supply, Rivers.

A 390,000 cu meter, nine meter deep storage reservoir was excavated at the Mery-sur-Oise water treatment facility to (1) furnish a reserve supply in case of unavailable river water and (2) allow equalization and preliminary purification. This was necessary because raw water quality was unreliable. A three days storage time proved optimum. A weak ozone treatment was applied upstream of the reservoir, and cleaning and drainage facilities were incorporated. (Cassar-FRC)
W81-06030

## 2I. Water In Plants

**SHALLOW GROUND-WATER CONDITIONS AND VEGETATION CLASSIFICATION, CENTRAL VOLUSIA COUNTY, FLORIDA,**
Geological survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05709

**ECONOMICS OF RAINFED CROPPING SYSTEMS: NORTHEAST THAILAND,**
Ford Foundation, Bangkok (Thailand).
S. H. Johnson III, and T. Charoenwatana.
Water Resources Research, Vol 17, No 3, p 462-468, June, 1981. 4 Fig, 10 Tab, 14 Ref.

Descriptors: *Crop production, *Farming, *Water use efficiency, Agriculture, *Rainfall, *Thailand, Rice, Legumes.

Computer modeling of effective rainfall showed that a flexible rainfed cropping system based on a legume crop planted before rice has a greater expected return (50%) than present subsistence rainfed cropping systems in northeast Thailand. At present, irrigation is impractical. The low soil fertility and organic matter, low water holding capacity, and erratic rainfall in the area have produced a system of monocropping--rice in the lower and upper paddies, kenaf and cassava in the uplands. The key to increasing productivity is the upper paddy area, which is intermediate in height and soil moisture between lower paddy and uplands. Basically, a legume crop is planted as soon as soil moisture is sufficent. If later rainfall is adequate, the legume is plowed under and rice planted. If not, the legume is allowed to mature and the field planted to rice or left fallow. Intercropping with peanuts, mungbeans, or sorghum between cassava or kenaf in the upper paddy areas increases the economic return by 60%. (Cassar-FRC)
W81-05818

**EFFECTS OF WATER STRESS AT VARIOUS GROTH STAGES ON SEED YIELD AND NUTRIENT CONCENTRATIONS OF FIELD-GROWN COWPEAS,**
California Univ., Riverside.
C. K. Labanauskas, P. Shouse, and L. H. Stolzy.
Soil Science, Vol 131, No 4, p 249-256, April, 1981. 4 Tab, 14 Ref.

Descriptors: *Water stress, *Seeds, *Plant growth, Crop yield, *Nutrients, Drought, Irrigation, Nitrogen, Heavy metals.

Competition between agricultural and urban water users in semi-arid environments has created a need for better understanding of crop water requirements and crop yield relationships, including the effect of irrigation timing on crop yield. Since cowpeas are cultivated as an important source of dry beans for human consumption in many arid and semiarid regions, it is important to know the effects of water stress on nutrient concentrations in these seeds. Experiments were conducted to evaluate the effects of water shortages on cowpeas during the vegetative, flowering, and pod-filling stages of growth, with particular emphasis on the drought effects on yield of seeds and on nutrient concentrations in the seeds. Water stress during the vegetative stage had no significant effect on weed production when compared with a control group, but drought reduced seed yield by 44 percent when it occurred during flowering and by 29 percent when it occurred during pod-filling stages. Treatment plots subjected to drought conditions during both flowering and pod-filling stages experienced seed yield reductions of 67 percent. The concentrations of nitrogen, magnsium, iron, calcium, copper, and boron were significantly affected by differential groth-stage irrigation treatments. The concentration of nitrogen in the seeds was inversely proportional to the dry-weight seed yield. The seed yield was significantly lower in the second year of the experiments than in the first year, posibly due to higher temperatures during the second year. Several significant interactions between irrigation treatments and years were noted with respect to seed yields and concentrations of nitroen, potassium, phosphorus, calcium, magnesium, manganese, zinc, and iron in the seeds. (Carroll-FRC)
W81-05839

**PHOTOSYNTHESIS AND TRANSPIRATION IN LARGE FOREST-GROWN DOUGLAS FIR: DIURNAL VARIATION,**
Washington Univ., Seattle. Coll. of Forest Resources.
J. W. Leverenz.
Canadian Journal of Botany, Vol 59, No 3, p 349-356, 1981. 7 Fig, 36 Ref.

Descriptors: *Photosynthesis, *Transpiration, *Fir trees, Trees, Stomata, Conifers, Diurnal distribution.

A study was conducted to determine which environmental and physiological factors are primarily responsible for the natural diurnal variation in net photosynthesis in a large forest-grown Douglas-fir. An open gas exchange system was used to measure net photosynthesis, transpiration, and stomatal conductance of terminal shoots of Douglas fir. Correlations were developed between these physiological parameters and environmental variables on a cloudy day, on a cool partly sunny day, and on a day of high temperature and leaf-air vapor pressure difference. Diurnal variation in shoot water potential and intercellular space carbon dioxide concentration was found to have little effect on the physiological parameters. Leaf-air vapor pressure difference and/or leaf temperature was found to have considerable influence on days of high temperatures. On completely overcast days, there was a strong correlation between net photosynthetic rate and photon flux density. Since stomatal conductance saturated at lower photon flux densities than net photosynthesis, the diurnal variation of net photosynthesis was not significantly affected by stomatal conductance on overcast days. When net photosynthesis was light saturated, intercellular space carbon dioxide concentration remained fairly constant and there were parallel responses by stomatal and residual conductances to vapor pressure difference and/or leaf temperature. (Carroll-FRC)
W81-05856

**THE INFLUENCE OF A SEVERE DROUGHT ON NET PHOTOSYNTHESIS OF WHITE OAK (QUERCUS ALBA),**
Univ.-Missouri Univ., Columbia. School of Forestry, Fisheries, and Wildlife.
P. M. Dougherty, and T. M. Hinckley.
Canadian Journal of Botany, Vol 59, No 3, p 335-341, 1981. 4 Fig, 22 Ref.

Descriptors: *Photosynthesis, *Oak trees, *Drought, Soil water potential, Trees, Moisture deficiency, Water requirements.

Although some aspects of the photosynthetic characteristics of leaves of white oak have been described, none of the previous studies have considered the impact of long-term exposure of leaves to low water potential or to high temperature on net photosynthesis. This study describes the impact of a drought occurring between early June and mid-October, 1976 on the actual and potential net photosynthesis and correlates the observed trends in net photosynthesis with plant and environmental factors which have previously been reported to control net photosynthesis in white oak. During the drought, soil water potential in the upper 45 centimeters of the soil profile decreased to below minus 2.5 MPa, and predawn xylem pressure potential was frequently less than minus 1.8 MPa. Average and daily maximum net photosynthesis decreased from 8.0 and 14.0 milligrams of carbon dioxide per decimeter squared per hour, respectively, during periods of high soil moisture to 1.0 and 8.0 milligrams of carbon dioxide per decimeter squared per hour, respectively, at the peak of the drought. Net photosynthesis seldom decreased below zero if quantum flux densities were greater than the compensation point during the period of record low soil moisture. Environmental conditions which reduced leaf temperatures and atmospheric evaporative demand increased net photosynthesis even though predawn xylem pressure potential was less than minus 1.8 MPa. The rates of net photosynthesis on cloudy days were within 80 percent of those observed under ideal soil moisture conditions. Drought resistance combines with a variety of other physiological traits to explain the relative success of white oak in the oak-hickory forest type. (Carroll-FRC)
W81-05857

**COTTON YIELD AND NUTRIENT UPTAKE IN RELATION TO WATER TABLE DEPTH,**
Science and Education Administration, Brawley, CA. Imperial Valley Conservation Research Center.
For primary bibliographic entry see Field 2G.
W81-05917

**A MODEL FOR THE WATER RELATIONS, PHOTOSYNTHESIS, AND EXPANSIVE GROWTH OF CROPS,**
Florida Univ., Gainesville. Dept. of Soil Sciences.
B. Zur, and J. W. Jones.
Water Resources Research, Vol 17, No 2, p 311-320, April, 1981. 9 Fig, 1 Tab, 38 Ref.

Descriptors: *Soil-water-plant relationships, *Model studies, *Photosynthesis, Mathematical models, Transpiration, Water loss, *Plant growth, Soil water, Cropland, Available water.

A mechanistic crop model was developed which assumes that the turgor potential of the leaf is the major parameter linking the water relations and transpiration flux of crops to their photosynthetic and expansive growth processes. A sensitivity analysis performed with the model demonstrated the relative importance of soil type, root zone depth, and root density in affecting some crop processes during a drying cycle. The model successfully simulated diurnal changes in the total leaf water potential and the turgor potential and reproduced the rates of transpiration, photosynthesis, and expansive growth under a range of soil and climatic conditions. Soil type and root zone depth had a significant influence on the time changes on the midday turgor potential values during a drying cycle. These time changes were gradual for clay soil, but went through an abrupt change and a fast decrease for the sand soil. Root zone depth had an essentially similar influence on the time change of turgor potential in both soils. Leaf-soil water potential gradients were lower for clay than for sand soil even when the transpiration flux was similar and at its potential value. The relationship between daily transpiration and soil water computed by this model agreed qualitatively with reported experimental results, although no assumption was made concerning a critical soil water potential. Results suggest that the main difference between a clay soil and a sand soil lies in the duration of the constant daily crop water loss stage. (Baker-FRC)
W81-05996

**THE STATE OF THE WORLD'S TROPICAL FORESTS,**
For primary bibliographic entry see Field 2A.
W81-06015

THE ORIGIN, COMPOSITION AND DOWNSTREAM TRANSPORT OF PLANT MATERIAL IN A SMALL CHALK STREAM,
Freshwater Biological Association, Dorset (England). River Lab.
F. H. Dawson.
Freshwater Biology, Vol 10, No 5, p 419-435, October, 1980. 8 Fig, 3 Tab, 20 Ref.

Descriptors: *Plant populations, *Streamflow, Streams, Leaves, Plant tissues, Stream pollution, Macrophytes, Dorset, England.

The Bere Stream, a small chalk stream and tributary of the River Piddle, was studied for 500 meters downstream of the source lake, Millum Head, at Hollybush near Bere Regis in Dorset, England. Two similar lengths of stream were separated by screens of five millimeter mesh across the entire stream width at their upper and lower limits. Material transported downstream was collected for three years. The order of breakdown was: less than two weeks for the emergent herbaceous macrophyte Rorippa nasturtium-aquaticum; two to three months for the dominant submerged macrophyte Ranunculus calcareus, and four to six months for the terrestrial material, mainly leaves of Salix viminalis and Fraxinus excelsior. The structure of the material, its composition and the time of availability relative to the seasonal changes of discharge all influenced the degree of fragmentation of material. The breakdown order coincided with an increasing ratio of carbon/nitrogen in the materials. Total annual movement of plant material was 231-426 kg dry weight for both sites, but a considerable variation in specific type of plant material was noted. Aquatic material was fragmented more than terrestrial material on an areal basis with equal inputs of aquatic and terrestrial material, and thus more of the latter was transported downstream. The aquatic macrophytes in the open section of the stream retarded the progress of terrestrial allochthonous material and resulted in a substantial increase in fragmentation of this material, which would have been lost to this part of the stream. (Baker-FRC)
W81-06033

## 2J. Erosion and Sedimentation

THE DYNAMICS OF RIVERS AND THEIR RESPONSE TO MAN AND NATURE,
Army Engineer Dist., Vicksburg, MS.
For primary bibliographic entry see Field 6G.
W81-05748

EFFECT OF NAVIGATION DAMS ON BANKS OF OHIO RIVER,
For primary bibliographic entry see Field 4A.
W81-05751

MULTI-FACTOR ANALYSIS OF BANK CAVING ALONG A NAVIGABLE STREAM,
D. J. Hagerty.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 463-493, 6 Fig, 2 Tab, 25 Ref.

Descriptors: *Waterways, *Bank erosion, *Flood damage, *Dams, *Water level fluctuations, Barges, Boats, Land use, Wave action, Alluvial rivers, *Ohio River.

Bank caving along the Ohio River has caused anxiety to landowners and has prompted a study of bank caving which encompassed the entire length of the Ohio River from Pittsburgh to Cairo, Illinois. Bank failure and caving on the Ohio River are complex phenomena, episodic and resulting from an interplay of causative factors. Usually this interplay of causative factors is sequential. The erosive and tractive forces created by flowing water during floods, and the gravitational forces and water pressures created in stream banks during the recession of flood waters are predominant causes of bank recession on the Ohio River and on many alluvial streams. However, bank caving and erosion caused by water flowing out of banks is also a very significant activity. Bank erosion has been documented and recorded for more than 150 years on the Ohio River. Construction and operation of navigation dams have not significantly intensified or accelerated bank caving and erosion on the Ohio River. Vessel waves are insignificant in comparison to other factors. However, the turbulence created by propeller wash and the direct impacts of towboats operating very close to river banks may have significant effects on specific sites. Changes in land use, particularly changes in the application of water to the land or the drainage or removal of water from the land adjacent to river banks, may have very significant effects on bank stability and slope failures. (Moore-SRC)
W81-05752

AVERAGE ANNUAL SEDIMENT YIELDS IN MINNESOTA,
CMI Corp., Elk Point, SD.
M. A. Otterby, and C. A. Onstad.
Agricultural Research Service, Peoria, Illinois, Agricultural Research Results ARR-NC-8, August, 1981. 9 p, 5 Fig, 2 Tab, 11 Ref.

Descriptors: *Sediment yield, *Watersheds, *Water pollution, Seasonal distribution, Sediment concentration, Temporal distribution, Precipitation, Flow duration, *Model studies, Sediment load, *Minnesota.

Models are presently being developed that route sediment from upland sources through watersheds, but these models generally need to be calibrated to watershed yield. Data are analyzed from 23 Minnesota watersheds to obtain estimates of such yields, to classify areas of Minnesota by general sediment-yield categories, and to estimate monthly distribution of sediment yields. The yields, ranging from 10 to 1,084 kg/ha/yr, were predicted on the basis of sediment-rating curves and flow-duration curves. The average basin yields, as well as such parameters as land use, soils, basin size, and geomorphology, were used to divide the state into various sediment-yield categories. Monthly distributions of precipitation, flow, sediment yield, and sediment concentrations also were derived. The distributions derived from Geological Survey data were averaged over 58 station years of data. In general, the basins in the forest regions of the central and northern portions of the state had a low sediment yield, except for the Little Fork and St. Louis basins. The rivers of the Red River Valley carry little sediment, but the topography, soils, and cropping practices in the southern part of the state cause heavier sediment loads. The southeastern part of the state has the highest yields, exceeding 1,050 kg/ha/yr. (Moore-SRC)
W81-05755

LONG-TERM DISTRIBUTIONS OF ANNUAL SEDIMENT YIELDS FROM SMALL WATERSHEDS,
Oregon State Univ., Corvallis. Dept. of Electrical and Computer Engineering.
J. Van Sickle.
Water Resources Research, Vol 17, No 3, p 659-663, June, 1981. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Small watersheds, *Sediment yield, *Distribution patterns, Watersheds, Cascade Mountains, Temporal distribution, Mountains, Logging, Rainfall-runoff relationships, Stochastic process, Sampling, Model studies, Statistical analysis, *Steep mountain watersheds, Northwestern U.S.

Annual sediment yields from small (less than 20 sq km), steep mountain watersheds in the northwestern U.S. are approximately log normally distributed over time. This property appears to result from three general empirical characteristics of sediment transport in small streams: (1) most of the load is carried during brief, high-intensity runoff events, (2) frequency curves of discharge intensity have a pronounced positive skew, and (3) sediment load and discharge are related by a power function. Log normal distribution is also produced by stochastic sediment yield models and observed data (5-20 years) from watersheds in the Pacific Northwest. This log normal distribution property can be used in interpreting and sampling annual yield data. The median annual yield becomes a more descriptive summary statistic than the mean annual sediment yield. Predisturbance vs. postdisturbance comparisons in a timber area may be made statistically rather than by using a control area. The sampling time needed to accurately estimate the median yield can be determined; in the case of the watersheds studied in this paper, it ranged from 3 to 19 years, most being over 8 years. This confirms the known fact that long-term monitoring of these highly variable watersheds is necessary for characterizing annual sediment production. (Cassar-FRC)
W81-05823

EROSION SUSCEPTABILITY OF THE VIRGINIA CHESAPEAKE BAY SHORELINE,
Virginia Inst. of Marine Science, Gloucester Point.
P. S. Rosen.
Marine Geology, Vol 34, No 1/2, p 45-59, January, 1980. 9 Fig, 1 Tab, 20 Ref.

Descriptors: *Erosion, *Shores, *Chesapeake Bay, *Virginia, Bays, Drainage, Waves, Salt marshes, Tidal marshes.

This investigation was designed to define the susceptibility of different shore morphologies to erosion, using the Virginia Chesapeake Bay shoreline as the area of study. The coastal environment in this area is affected by the relict Pleistocene high-order dendritic drainage system, which results in a large diversity of shore orientations; the moderate but highly variable wave energy and highly variable submergence rates which result in a spectrum of shoreline transformation from primary to secondary types; exposures of coastal plain sediments of widely varying composition and volume; and diverse salt marsh development. Three morphologically distinct beach environments comprise 80% of the shore, each one reflecting different susceptibilities to to erosion. A large variability was noted in the local subsidence rates along the shoreline. The subsidence highs corresponded to the areas with largest nearshore terraces and the main concentrations of salt marsh development. A balance in the shore stability exists as a result of salt marsh development. The marsh retards shore erosion, and yet erosion occurs at the areas of highest local submergence where the highest shoreline retreat is expected. Impermeable beaches, composed of a veneer of sand overlying an impermeable layer, have the greatest susceptibility to shore erosion. This is due to the combined influence of low swash infiltration, low beach elevation, and groundwater effects. (Baker-FRC)
W81-05828

A MICROPROCESSOR AUTOMATED RILL-METER,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Center.
For primary bibliographic entry see Field 7B.
W81-05865

MINERALOGY OF A CHRONOSEQUENCE FORMED IN NEW RIVER ALLUVIUM,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agromomy.
W. G. Harris, S. S. Iyengar, L. W. Zelanzny, J. C. Parker, and D. A. Lietzke.
Soil Science Society of America Journal, Vol 44, No 4, p 862-868, July/August, 1980. 1 Fig, 6 Tab, 34 Ref.

Descriptors: *Mineralogy, *Alluvium, *Fluvial sediments, Rivers, River beds, Silt, Clays, Clay minerals, Alluvial rivers, Aging, Soil, Sedimentology, Bottom sediments, Sand, Particle size, Iron, Quartz, *New River, Virginia.

The mineralogy of four soils (T0, T1, T2, T3) from the alluvium of New River was studied for differences due to age. Percent Fe and clay illuviation increased with age. In the older T0 and T1 soils, quartz, feldspar, mica, and amphibole are the main sand sized minerals. Quartz and resistant heavy minerals predminant in T2 and T3, suggesting a wide time gap between T1 and T2. Trends in silt

mineralogy were similar to those of sand. Hydroxy interlayered vermiculite becomes the dominant clay-sized mineral in Ap horizons with time, while vermiculite and kaolinite increase in depth. Whold-soil studies reveal illuviation and a concentration of quartz at the surface with time. Evidence is presented which suggests that stability is reached more rapidly in fine size fractions than in coarser ones. (Geiger-FRC)
W81-05866

**THE IMPACT OF ACTIVE SEDIMENTARY PROCESSES ON LAND-USE PLANNING ALONG A SOUTH TEXAS BARRIER ISLAND,**
W. F. Cole.
Bulletin of the Association of Engineering Geologists, Vol 18, No 1, p 1-6, 1981. 2 Fig, 6 Ref.

Descriptors: *Beach erosion, *Sediment transport, *Storm surges, Erosion, *San Padre Island, *Texas, Land use, Coastal zone management, Hurricanes, Washouts, Dunes, Planning, Sewer systems, Flood control.

Results of allowing development to proceed in coastal areas witout considering natural processes (hurricanes and shoreline erosion) are destruction of buildings in the washover channels, sewer backup, water shortages, and interference with vehicular traffic. In 1978 the moderate tropical storm Amelia backed up sewer lines and caused flooding on South Padre Island, Texas. Maps of the barrier island from 1948 to 1969 show the gradual changes caused by daily shoreline processes and the severe alterations caused by hurricanes. After Hurricane Beulah in 1967 a large washover channel and many openings in the foredune ridge developed. The storm effects were exacerbated by construction of hotels and residences and destruction of the foredune ridge in some places. It is recommended that the foredune ridge not be disturbed for building purposes. Sand should be added along the beach, placed in low spots in the ridge, and stabilized with vegetation. Expensive buildings should be built behind the foredune ridge, and residences in back-island areas not exposed to washover channels. (Cassar-FRC)
W81-05867

**COLLAPSIBLE-BAG SUSPENDED-SEDIMENT SAMPLER,**
Geological Survey, Lakewood, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W81-05904

**TEMPORAL AND VERTICAL DISTRIBUTION OF CILIPHORAN COMMUNITIES IN THE BENTHOS OF A SMALL EUTROPHIC LOCH WITH PARTICULAR REFERENCE TO THE REDOX PROFILE,**
Stirling Univ. (Scotland). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W81-06020

**FURTHER STUDIES ON THE PALAEOLIMNOLOGY AND CHANGES IN THE PHOSPHORUS BUDGET OF BARTON BROAD, NORFOLK,**
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2H.
W81-06022

**DEPOSITION RATES IN THE GODAVARI DELTA,**
Andhra Univ., Waltair (India). Dept. of Geology.
M. Kalesha, K. S. Rao, and B. L. K. Somayajulu.
Marine Geology, Vol 34, No 1/2, p M57-M66, January, 1980. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Deltas, *Trace elements, Aluminum, Iron, Magnesium, Calcium, Titanium, Cobalt, Chromium, Vanadium, Zinc, Strontium, Nickel, Copper, Rubidium, Potassium, Salts, Chemical composition, Godavari Delta, *India, Spectrophotometry, Sediments, Sediment transport, *Fluvial sediments.

Several gravity cores were collected during December 1975 and January 1976 from the deltaic regions of the Godavari River, which drains about 1.2% of the total suspended material carried by Indian rivers into the Bay of Bengal. Cores were studied for mineralogy and major and minor element compositions. The sand, silt and clay contents of the cores along with the excess lead activities were determined. The cores were mainly clay and silty. The clays were composed of 42-69% montmorillonite, 13-34% illite, and 10-30% kaolinite. Chlorite was present in traces. The concentrations of Al, Fe, Mg, Mn, Cr, Ni, and Sr in the Godavari delta sediments are about the same as those of the suspended material upstream in the Godavari River at Rajhmundry, whereas Ca is lower and Cu is higher compared to the latter. The Fe, Mn, Ni, and Sr concentrations of the deltaic clays are similar to those of the Bay of Bengal core. Deltaic clay material is perhaps the best example of unaltered detrital input to the ocean, and studies of this type from various delta regions of all the rivers draining to the Bay of Benaal as well as into the rest of the oceans are essential for estimating dependable average inputs of detrital material into the open oceans. (Baker-FRC)
W81-06035

**EXPERIMENTAL STUDY OF FREE-SURFACE FLOW INSTABILITY AND BEDFORMS IN SHALLOW FLOWS,**
Geological Survey of Israel, Jerusalem.
I. Karcz, and D. Kersey.
Sedimentary Geology, Vol 27, No 4, p 263-300, November, 1980. 17 Fig, 85 Ref.

Descriptors: *Erosion, *Unsteady flow, *Shallow water, Varied flow, Surface flow, Waves, Sedimentology, Laminar flow, Overland flow.

Three series of experiments were performed to test erosion and development of bed sculpture in unstable, pulsating shallow flow. A 10-m flume was used which had flows of Reynolds number up to 1000, Froude number up to 3.0, and slope up to 2%. The bed was rigid in the first series of 59 runs, was made from well-sorted sand in the second series of 50 runs, and was made of poorly sorted sand in the final series of 10 runs. Flow surface instability developed above the rigid bed in the following stages: smooth surface, small wavelets, well-developed waves, and rough flow. The second series showed the following steps: smooth bed flow, flow-aligned ridge and trough pattern, combined ridge and rhomboid pattern, and rhomboid configuration. When there was flow instability, ridge patterns formed in flows with mean values indicative of laminar-subcritical regime, combined ridge and rhomboid patterns in laminar-supercritical regime, and rhomboid patterns in flows with mean values indicative of transitional turbulent-supercritical regime. Transverse segregation of the bed material across the ridges was demonstrated by the third series of experiments. Thus, laminar and transitional flows already become unstable when the Froude number equals 1/2, and pulsations may appear in sheet flows and overland flow which would intensify erosion and sediment. (Small-FRC)
W81-06040

**DYNAMICS AND SEQUENTIAL ANALYSIS OF A MESOTIDAL SHOAL AND INTERSHOAL CHANNEL COMPLEX IN THE EASTERN SCHELDT (SOUTHWESTERN NETHERLANDS),**
Utrecht Rijksuniversiteit (Netherlands). Comparative Sedimentology Div.
S-D. Nio, J. H. van den Berg, M. Goesten, and F. Smulders.
Sedimentary Geology, Vol 26, No 1/3, p 263-279, April, 1980. 1 Fig, 25 Ref.

Descriptors: *Shoals, *Sedimentary structures, Bottom currents, Sandbars, Mudflats, Sand, Bottom sediments, Sand waves, Flumes, Sediments, Erosion, Channeling, Channels, Rills, *Netherlands, Morphology.

A study of bedforms and their internal sedimentary structures in relation to morphological changes through time was conducted from a mesotidal inshore environment, where shoals and their dynamically intersecting channels are dominant. The study area was the Eastern Scheldt basin, southwestern Netherlands, which was formed during the latest Holocene rise in sea level. It presently consists of three major tidal channels, separated by several shoals, which are dissected by smaller intershoal channels. With a mean tidal range of about 3.00 meters, the environment is mesotidal. Mean spring and neap tidal ranges are 3.50 and 2.30 meters, respectively. Owing to the lateral shifting of the intershoal channel, net sedimentation within the inner margin is dominant. Net sedimentation within the outer margin is minimal. Preserved sequences will mostly demonstrate a succession of horizontal to low-angle laminated sets with intercalations of small-scale cross-bedded units. Based on the dimensions of the sedimentary structures found, it is concluded that low-energy depositional processes were dominant. However, relatively high-energy processes may have produced a sequential upbuilding consisting of small-scale structures. Shoal accretion was realized by the migrational pattern of small and numerous intershoal channels. (Baker-FRC)
W81-06041

**SEDIMENTARY FACIES AND DEPOSITIONAL HISTORY OF THE SWAN ISLANDS, HONDURAS,**
Texas Christian Univ., Fort Worth. Dept. of Geology.
M. L. Ivey, Jr., J. A. Breyer, and J. C. Britton.
Sedimentary Geology, Vol 27, No 3, p 195-212, October, 1980. 11 Fig, 12 Ref.

Descriptors: *Sedimentology, *Marine sediments, *Geologic history, Marine geology, Geologic formation, Deposition, Sedimentary rocks, Swan Islands, Honduras.

The geologic history of Swan Island, a Honduran possession in the western Caribbean, is discussed, including sedimentary facies. There are two sedimentary assemblages: an older bedded sequence of mid-Tertiary age and a younger Late Pleistocene sequence. The older sequence of calcarenites, calcilutites, and siliciclastic mudstones, are capped by cliff-forming reefal carbonates of the younger sequence. The older bedded sequence was formed in deep water. There was a constant rain of pyroclastic debris, with some episodes of upslope carbonate material deposited by turbidity currents. Uplift and deformation occurred after the Early Miocene, and by the Late Pleistocene, rocks had been uplifted into water depths where coral grew. Pleistocene sedimentation was controlled by the interaction between tectonic uplift and eustatic sea-level changes. The tectonic history was primarily influenced by the island's proximity to the boundary between the North American and Caribbean plates. (Small-FRC)
W81-06042

## 2K. Chemical Processes

**COMPARISON OF WATER ADSORPTION BY MONOVALENT EXCHANGE ION FORMS OF SOIL HUMIC MATERIAL AND SYNTHETIC EXCHANGES,**
Florida Univ., Gainesville. Dept. of Soil Science.
V. E. Berkheiser.
Soil Science, Vol 131, No 3, p 172-177, March, 1981. 2 Fig, 4 Tab, 16 Ref.

Descriptors: *Humic acids, *Adsorption, *Soil absorption capacity, *Ions, Organic matter, Lithium, Sodium, Potassium, Cesium, Alkali metals, Enthalpy, Entropy, Chemical properties, Soil organic matter.

The amount of water adsorbed by humic materials saturated with monovalent cations depends on the nature of the saturating cation and the strength of interaction of the cation with the humic surface. The amounts of water adsorbed by the cation-humic complexes were directly related to the absolute standard enthalpy of hydration in the series, Li+, Na+, K*, and Cs+. The tetramethylam-

monium-humic complex adsorbed more water than was predicted from the absolute standard enthalpy of hydration. A more linear relationship was obtained when the absolute standard entropy was plotted against the water adsorbed. Free energies of adsorbed water on synthetic exchangers, such as acrylic, benzoic, sulfonic, phenolic, and selenoic, varied from -0.05 to -1.67 (humic acid, -0.71) kcal per mole. Other possible factors contributing to the amount of water adsorbed are acidity of exchange sites and cross-linking in the humic material. (Cassar-FRC)
W81-05838

**PHYSICAL WAYS TO CONTROL BUILD-UP OF 'RUST' IN WELLS,**
Regina Univ. (Saskatchewan). Dept. of Microbiology.
For primary bibliographic entry see Field 5F.
W81-05886

**TEMPERATURE AND WATER ACTIVITY AS VARIABLES IN SOIL MINERAL ACTIVITY DIAGRAMS,**
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
S. V. Mattigod, and J. A. Kittrick.
Soil Science Society of America Journal, Nov 44, No 1, p 149-154, January/February, 1980. 2 Fig, 3 Tab, 37 Ref.

Descriptors: *Soils, *Minerals, Temperature, Water supply, Thermodynamics, Phase diagrams, *Chemical reactions, Chemical properties, *Soil chemistry, Weathering, Chemical weathering.

A temperature dependent activity diagram, needed for the study of chemical weathering of soil minerals under wide ranging temperature conditions, was constructed for the K2O-A12O3-SiO2-H2O system. The diagram indicated that between 25 and 95C, the kaolinite-gibbsite equilibrium changes over a four-fold increase in Si(OH)4 concentration. The diagram also predicts that the equilibrium solubility of quartz changes roughly five-fold and that of amorphous silica changes nearly three-fold within the same range of temperature. It was also shown for the same four component system that the change in activity of water significantly alters the thermodynamic stability relationships between various minerals. It appears that the activity of water is an important variable in activity diagrams applied to chemical weathering studies of minerals in arid and salt affected soils and sediments. (Baker-FRC)
W81-05905

**TRANSPORT OF ORGANIC CARBON IN THE WORLD'S RIVERS,**
Duke Univ., Durham, NC. Dept. of Botany.
For primary bibliographic entry see Field 2A.
W81-05991

**DEPOSITION RATES IN THE GODAVARI DELTA,**
Andhra Univ., Waltair (India). Dept. of Geology.
For primary bibliographic entry see Field 2J.
W81-06035

**INFLUENCE OF ENVIRONMENTAL FACTORS UPON THE LEACHING OF CATIONS FROM UNDISTURBED MICROCOSMS OF BEECH AND SPRUCE LITTERS,**
Liege Univ. (Belgium). Dept. of Botany.
For primary bibliographic entry see Field 2G.
W81-06036

## 2L. Estuaries

**EROSION SUSCEPTABILITY OF THE VIRGINIA CHESAPEAKE BAY SHORELINE,**
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 2J.
W81-05828

**SINGLE AND SUPERIMPOSED BEDFORMS: A SYNTHESIS OF SAN FRANCISCO BAY AND FLUME OBSERVATIONS,**
Geological Survey, Menlo Park, CA.
D. M. Rubin, and D. S. McCulloch.
Sedimentary Geology, Vol 26, No 1/3, p 207-231, April, 1980. 12 Fig, 2 Tab, 39 Ref.

Descriptors: *Sedimentary structures, Seismic properties, Seismology, Geophysics, Sonar, *Bottom sediments, Cameras, Bottom currents, Sand, *Sand waves, Bays, *San Francisco Bay, Flumes, Sediments, Morphology.

The bottom of the central bay area of San Francisco Bay was surveyed during two cruises. The first was conducted when tides had the mean tidal range and tidal currents had mean maximum velocities. The second cruise selected sand-wave fields for survey over the entire tide cycle when currents had velocities approaching the highest of the year. A side-scanning sonar system was used. Dunes and sand waves cover about half of the area studied. They are straight-crested, sinuous, catenary, or lunate, in plan view. In cross-section they are triangular, or convex upstream. Heights range from less than 20 cm to more than 8 m. Beds that appear flat are the second most abundant bottom type observed in the central bay. Bedrock and boulders occur mostly in the Golden Gate area, where fast currents keep the bed swept clean of sand. In some areas, the boulders and bedrock locally protrude through a sand veneer, while in other areas boulders are numerous enough to form a boulder pavement. Comparison of bedform sequences suggests that for flows up to tens of meters deep, beds of 0.25-0.50 mm sand respond to increasing flow velocities by forming ripples, two dimensional sand waves, three dimensional sand waves, and flat beds. In the bay, in contrast to flumes, sand waves with the largest height-to-depth ratios occur in relatively coarse sand. The distribution of small bedforms superimposed on larger bedforms reflects lateral and vertical variations in shear velocity in flow over large bedforms. (Baker-FRC)
W81-05830

**PRODUCTIVITY OF ALGAL EPIPHYTES IN A GEORGIA SALT MARSH: EFFECT OF INUNDATION FREQUENCY AND IMPLICATIONS FOR TOTAL MARSH PRODUCTIVITY,**
Wisconsin Univ., Madison. Dept. of Botany.
R. C. Jones.
Estuaries, Vol. 3, No. 4, p 315-317. December, 1980. 1 Tab, 10 Ref.

Descriptors: *Salt marshes, *Productivity, *Frequency analysis, *Epiphytes, *Biological samples, Estuaries, Estuarine environment, Flooding, Biomass, Aquatic productivity, Primary productivity, Carbon, Photosynthesis, On-site investigations, Sampling, Marsh plants, *Georgia.

Primary production by algal epiphytes in a Georgia salt marsh was measured using the Carbon 14 technique. The effects of light intensity, inundation frequency, and location on carbon fixation at two sites along a salt marsh creek were quantified. Algae inundated daily fixed carbon more rapidly than those which had dried for several days. In general, algae at lower stem heights fixed more carbon than algae on upper sections. Light-stem height and light-site interactions were not significant. These results corroborate studies showing desiccations is not always a severe stress for intertidal algae. similarity of epiphyte algal productivity to that of salt marsh benthic diatoms suggests that, given adquate substrate, the epiphytes may be an important source of primary production during some seasons of the year. (Titus - FRC)
W81-05882

**ON THE MEASUREMENT OF TIDAL EXCHANGES AND GROUNDWATER FLOW IN SALT MARSHES,**
Marine Biological Lab., Woods Hole, MA. Boston Univ. Marine Program.
I. Valiela, J. M. Teal, S. B. Volkmann, C. M. Cogswell, and R. A. Harrington.
Limnology and Oceanography, Vol 25, No 1, p 187-192, January, 1980. 3 Fig, 9 Ref.

Descriptors: *Salt marshes, *Groundwater movement, *Tidal currents, Nutrients, Fluctuations, Water table fluctuations, Tidal marshes.

Problems involved in measuring tidal exchanges and groundwater flow in salt marshes are described. The first problem is to obtain estimates of nutrient and particulate concentrations by sampling at fairly short intervals over a complete tidal cycle. The sampling cannot be done just once during the ebb and once during the flood stage, even if replicated. A more difficult problem is proper estimation of water flow. Ideally, continual records of total flux would be used. Hourly measurements of flow rate with mechanical flowmeters can be used instead. Since the rating for volume per time interval is always much larger than the concentration term, small errors in measuring flux will lead to large errors in estimates of exchanges. Studies indicate that the conversion of groundwater nitrate to reduced compounds by the salt marsh is particularly important. (Baker-FRC)
W81-05922

**SOILS OF MARSHES IN THE APALACHICOLA, FLORIDA ESTUARY,**
Florida A and M Univ., Tallahassee.
C. L. Coultas.
Soil Science Society of America Journal, Vol 44, No 2, p 348-353, March/April, 1980. 1 Fig, 4 Tab, 22 Ref.

Descriptors: *Marshes, *Soil types, Apalachicola, *Florida, Wetlands, Estuaries, Plants, Ecosystems, *Apalachicola River estuary.

Research was conducted to characterize and classify the soils of the marshes in the Apalachicola River estuary. These soils are developing in deltaic sediments at the mouth of the river. Sampling sites were selected after the tidal marshes were traversed in several places. Major soils were sampled with a bucket-type auger. Mineralogy of the clay fraction was determined by X-ray diffraction. Cladium jamaicense (sawgrass) was the most common plant in this ecosystem, but Juncus roemerianus (needlebrush) was also present. Sulfihemists predominated in the delta of the Apalachicola River. In the eastern part of the estuary, Sulfaquents and Fluvaquents were common. Sulfihemists were not saline, but some Sulfaquents and Fluvaquents were saline-alkaline. Montmorillonite was the predominant clay-sized mineral and mica was common in the sand fraction. (Baker-FRC)
W81-05932

**EFFECTS OF TIDES ON MIXING AND SUSPENDED SEDIMENT TRANSPORT IN MACROTIDAL ESTUARIES,**
Centre Oceanologique de Bretagne, Brest (France).
G. P. Allen, J. C. Salomon, P. Bassoullet, Y. Du Penhoat, and C. De Grandpre.
Sedimentary Geology, Vol 26, No 1/3, p 69-90, April, 1980. 13 Fig, 36 Ref.

Descriptors: *Tidal effects, *Estuaries, *Sediment distribution, Tides, Neap tides, Spring tides, Sedimentology, Atlantic Coast, *France.

Numerous studies on the estuaries on the French Atlantic coast are summarized which have shown that in macrotidal estuaries, semidiurnal and fortnightly tidal cycles are significant parts of the hydrological and sedimentological processes. During the neap-spring tidal cycle, there are large variations in mixing caused by changes in the ratio of river flow to tidal volume. The estuaries can change from a relatively well mixed state during spring tides to partially mixed or even stratified during neap tides. These changes in average tidal water volume produce a residual increase during the increasing tide range and a residual seaward discharge during decreasing tide range. This purely tidal effect can influence freshwater and sediment flow from the estuary. The semidiurnal tidal cycle alternately erodes, resuspends, and deposits large amounts of fine sediments. A tidal sediment trap seems to be created by upstream transport of suspended sediments caused by the ebb-flood asymmetry of the shoaling tidal wave.

Thus, neap-spring tides control sedimentation and seaward escape of suspended sediment, while spring tides cause large-scale erosion and resuspension. (Small-FRC)
W81-05933

**BIOSEDIMENTOLOGICAL ZONATION OF BOUNDARY BAY TIDAL FLATS, FRASER RIVER DELTA, BRITISH COLUMBIA,**
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
D. D. Swinbanks, and J. W. Murray.
Sedimentology, Vol 28, No 2, p 201-237, April, 1981. 22 Fig, 5 Tab, 73 Ref.

Descriptors: *Tidal flats, *Sediment grading, *Benthic fauna, Fraser River Delta, *British Columbia, Deltas, Algae, Eelgrass, Aquatic plants, Aquatic animals, Shrimp, Invertebrates, Sand waves, Zones, Bioindicators.

The Boundary Bay tidal flats of the Fraser Delta have little variation in sediment grain size, consisting of fine to very fine and well to very well sorted sands. Therefore, it is possible to study the causal relationships between floral and faunal zonation without complications from sediment grain size variability. Five floral zones were distinguished. The farthest inland zone, the salt marsh, has a maximum duration of continuous exposure of 12 to 40 days. The algal mat is continuously exposed for 1 to 2 day periods; the eelgrass zone, from 0.5 to 0.8 days. The upper and lower sand wave zones are shoreward and seaward, respectively, of the eelgrass zone. Macrofaunal organisms surveyed over two transects showed definite restrictions in habitat according to time of exposure to water. Callianassa californiensis, a thalassinidean shrimp which excavates unlined temporary feeding burrows, extends to a level just below mean higher high water where maximum continuous exposure rises abruptly from 4 to 9 days. Upogebia pugesttensis, another thalassinidean shrimp, which builds mud-lined permanent dwelling burrows, is restricted to below mean sea level, where continuous exposure does not exceed 0.5 days. This paper concludes that tidal exposure is a fundamental factor in organisms distribution in tidal flats. (Cassar-FRC)
W81-05934

**EFFECTS OF SEASONAL CHANGES ON THE SEDIMENTARY REGIME OF A SUBARCTIC ESTUARY, RUPERT BAY (CANADA),**
McGill Univ., Montreal (Quebec). Marine Sciences Centre.
B. D'Anglejan.
Sedimentary Geology, Vol 26, No 1/3, p 51-68, April, 1980. 10 Fig, 1 Tab, 18 Ref.

Descriptors: *Estuaries, *Sediment transport, *Seasonal variation, Clays, Tidal effects, Ice cover, Deposition, *Sedimentation, *Rupert Bay, Canada.

Sediment transport and deposition in Rupert Bay, Canada, are influenced by strong seasonal fluctuation in climate. The 875 sq km estuarine embayment opens into the James Bay south of Hudson Bay, Canada. It has a continuous ice cover for nearly six months, with a rapid breakup and spring discharges which are as much as sixteen times the yearly minima. Three large rivers discharge a combined total of 2350 cu m/sec into the James Bay, and provide the main source of the poorly sorted silty clays which form the present deposits. During the open season, there is high turbidity with a pronounced streakiness in the flow direction and stable fronts at the boundaries of the river plumes. Deposition is hindered by tidal and wind turbulence. Seaward tidal flushing of the river sediments takes place. When the estuary is under ice-cover, there is a pronounced decrease in suspended sediment, which indicates that settling occurs under the ice-cover. The winter deposits are, for the most part, returned to the water column in the spring. Measurements of the Cs-137 activity in the surface deposits confirmed low current depositional rates. (Small-FRC)
W81-05935

**USE OF THE EQUATIONS OF CHEMICAL KINETICS TO ASSESS THE EFFECT OF THE CONCENTRATIONS OF DISSLVED OXYGEN ON THE RATE OF ITS UPTAKE BY MICROORGANISMS IN NATURAL WATER,**
State Oceanographic Inst., Moscow (USSR).
A. V. Leonov.
Hydrobiological Journal, Vol 16, No 1, p 59-65, 1980. 3 Fig, 2 Tab, 22 Ref.

Descriptors: *Microorganisms, *Oxygen demand, *Biological oxygen demand, Adenosine triphosphat:, Kinetics, Sea water, Metabolism, Absorption, Dissolved oxygen.

The effect of the initial content of oxygen dissolved in water on the rate of biochemical oxygen demand (BOD) is considered. When there is an appreciable reduction of oxygen content in the water, the respiratory regime of microorganisms is governed by the physiological and biochemical reconstruction of their internal structures. When dissolved oxygen concentration is low, regulators of respiration form and accumulate in the cells, and their content reaches a maximum at some low oxygen concentration. The content of all cytochromes in the bacterial cell declines on transition to anaerobic conditions. Alteration in the rate of oxygen demand relative to its content is directly connected with the end stage of ATP synthesis. At low dissolved oxygen concentrations, the substrates present in the water play an appreciable part in the formation of energy resources by biological objects. However, no effect of oxygen content on the rate of oxygen demand is noted when use is made of water stored under laboratory conditions in which the reserve of natural organic matter has been exhausted. The enrichment of such water with organic compounds, reflects only the effect of the substrate concerned on the system as a whole, resulting in the formation of ocrresponding rates of oxygen demand. (Baker-FRC)
W81-05967

**CONTEMPORARY ACCUMULATION OF MARINE SAND IN A MACROTIDAL ESTUARY, SOUTHWEST WALES,**
Imperial Coll. of Science and Technology, London (England). Dept. of Geology.
C. F. Jago.
Sedimentary Geology, Vol 26, No 1/3, p 21-49. April, 1980. 18 Fig, 37 Ref.

Descriptors: *Estuaries, *Sediment transport, *Deposition, Sands, Sedimentation, Marine environment, Tidal effects, Accumulation, Taf estuary, *Carmarthen Bay, Wales.

Accumulation of marine sand in the Taf estuary, Carmarthen Bay, southwest Wales, was studied. The macrotidal estuary's sand budget over a ten-year period shows that sand is accumulating at a mean vertical rate of 0.13 m or more per year. This rise in sand level is two orders of magnitude greater than the current rise of sea level. Analysis of the sand indicates that it is of marine origin, and the rate of accumulation indicates that it is deposited by westerly moving waves from the bay. Within the estuary, the tide is markedly asymmetrical; the flood is shorter than the ebb. A spring tide must rise 2 m from low water ebb to enter the partially sand-filled estuary. Generally, the tide pours in quickly. Fast ebb currents develop when the river is high. Circulation varies from moderately stratified to well-mixed. Storm waves from the Atlantic are pushing sand into the estuary from Carmarthen Bay. This accumulating sand causes the unusual estuarine dynamics. (Small-FRC)
W81-06032

## 3. WATER SUPPLY AUGMENTATION AND CONSERVATION

### 3A. Saline Water Conversion

**APPARATUS FOR DESALINATION AND PURIFICATION OF WATER BY REVERSE OSMOSIS AND ULTRAFILTRATION,**
Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (Germany, F.R.). (Assignee).
H. Timm, S. Fries, and A. Wenzlaff.
U.S. Patent No 4,228,014, 9 p, 6 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 685. October 14, 1980.

Descriptors: *Patents, *Desalination, *Separation techniques, Water purification, *Reverse osmosis, Filtration, Membranes, Desalination apparatus.

An apparatus for the desalination and purification of water by reverse osmosis and ultrafiltration includes dish-like carrier plates and water guide plates held between two end plates and alternately stacked one above the other. The apparatus also includes annular diaphragms which lie between respective carrier plates and guide plates and are each backed by a filter layer, so that in use untreated water flows over the diaphragms in the radial direction on the side opposite the filter layer, and permeate or water suitable for industrial use is drawn off at the side backed by the filter layer. The stack of end plates, carrier plates, and guide plate is clamped or held together at the periphery and has a continuous central aperture for the introduction of the untreated water. The carrier plates sealing engage one another by means of thickened marginal portions lying radially beyond the edges of the guide plates. The marginal portions have continuous bores which are aligned with one another and with bores in the end plates, and provide an outlet for the permeate. (Sinha-OEIS)
W81-05788

**WASTE HEAT RECOVERY CYCLE FOR PRODUCING POWER AND FRESH WATER,**
Biphase Energy Systems, Inc., Santa Monica, CA. (Assignee).
W. E. Amend, and W. R. Studhalter.
U.S. Patent No 4,227,373, 9 p, 8 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 471. October 14, 1980.

Descriptors: *Patents, *Desalination, *Desalination processes, *Separation techniques, Condensation, Brine, Energy, Waste heat utilization.

Steam is produced from aqueous brine, by a process that employs hot fluid, nozzles, and rotary separators. Process steps include: (a) transferring heat from the hot fluid to the brine, (b) passing the heated brine in pressurized state to the nozzles to flow through, and expanding the flow to form steam and liquid droplets, and (c) causing the expanded flow to rotate the rotary separator for forming a layer of brine on the separator and accompanied by steam separation for subsequent removal. The liquid from the rotating layer and/or the separated steam may be used to drive turbines; the hot fluid may comprise combustion products from a combustion source; and several stages of separators may be employed. (Sinha-OEIS)
W81-05796

### 3C. Use Of Water Of Impaired Quality

**HYDROGEOLOGY, ESTIMATED IMPACT, AND REGIONAL WELL MONITORING OF EFFECTS OF SUBSURFACE WASTEWATER INJECTION, TAMPA BAY AREA, FLORIDA,**
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 5E.
W81-05729

**PRODUCTION OF NON-FOOD-CHAIN CROPS WITH SEWAGE SLUDGE,**
PEER Consultants, Inc., Rockville, MD.
For primary bibliographic entry see Field 5E.
W81-05759

**WATER RE-USE PLAN ADVANCES IN NORTHGLENN,**
BioCycle, Vol 22, No 2, p 30-31, March/April, 1981.

Descriptors: *Water reuse, *Wastewater renovation, Water use, Irrigation, Agriculture, Drinking water, Aerated lagoons, Planning, Water demand.

A water reuse plan was devised for the City of Northglenn, Colorado in the 1970's when that city faced a water shortage. An agreement was worked out with a local formers' irrigation company. Under the plan water from Standley Lake would no longer flow directly to the farmers, but would first be piped to Northglenn for municipal use and then recycled for agricultural use. Stormwater and waste water would be collected, treated, stored and given back to the farmers for irrigation purposes. About 60% of the water borrowed from the farmers' irrigation company could be returned in this manner, while the other 40% would be obtained from deep wells and storm runoff. The farmers' company would be paid 10% interest, payable in water, not money, for this agreement. To treat the water that was to be applied on the farm land, Northglenn agreed to build a waste water treatment facility using aerated lgoons to bring the water to better than secondary treatment levels. After treatment the water will be pumped to winter storage reservoirs until the farmers need it. (Baker-FRC)
W81-05862

**IRRIGATING WITH LANDFILL LEACHATE,**
Idaho Univ., Sandpoint. Dept. of Plant Physiology.
H. A. Menser.
BioCycle, Vol 22, No 2, p 39-41, March/April, 1981. 3 Tab, 16 Ref.

Descriptors: *Irrigation, *Landfills, *Leachates, Sanitary landfills, Waste water, Percolation, Waste water treatment, Spray irrigation, Plant growth, Land disposal, *Impaired water use.

Results of exploratory greenhouse tests are reported which evaluated the use of leachate as a potential source of plant nutrients. A principal objective was to study leachate-tolerance thresholds in sand culture and to determine whether leachate stimulated or inhibited plant growth. Soybean seeds were planted in nine 11.5 cm plactic pots containing washed fine sand. Pots were placed above leachate and nutrient solutions. The lower parts of the pots were submerged in the solutions for 1 to 2 hr twice daily. Roots were aerated by allowing the solution to drain from the pot. It was determined that sanitary landfill leachate, a waste product of land disposal of solid waste and a potential environmental hazard, contains significant amounts of the nutrients needed for ideal plant growth. A modified hydroponic cultural system using leachate dilutions as a source of recycled nutrients apparently will not succeed unless excessive and unbalanced levels of micronutrients can be properly regulated. Hydroponic systems for recycling leachate through vegetation would require aeration or other means of stabilizing or complexing adverse factors that inhibit plant groth. (Baker-FRC)
W81-05863

**THE PRODUCTIVITY OF PISTIA STRATIOTES L. IN A EUTROPHIC LAKE,**
Ibadan Univ. (Nigeria). Dept. of Botany.
For primary bibliographic entry see Field 2H.
W81-06007

## 3D. Conservation In Domestic and Municipal Use

**STATE-OF-THE-ART SUMMARY OF INCENTIVES FOR RESIDENTIAL WATER CONSERVATION,**
National Bureau of Standards, Washington, DC. National Engineering Lab.
J. Elder.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-115958, Price codes: A03 in paper copy, A01 in microfiche. Report NBSIR 80-2119, October, 1980. 37 p, 3 Tab, 84 Ref.

Descriptors: *Water conservation, *Domestic water, *Consumer information, *Pricing, Attitudes, Education, Water shortage, Water metering, Economic aspects.

Water conservation programs are being discussed and implemented throughout the country. It appears, however, that unless there is a water crisis, these programs have little effect on domestic consumption. Two general motivations for individuals to save water are the conservation ethic concerning the use of natural resources, and financial incentives. Consumer education and information programs generally focus on encouraging a conservation ethic. Consumer programs encourage water conservation by providing material on water conservation devices and tips on water conservation practices. Feedback techniques and rate structures rely to a large extent on financial incentives to encourage conservation. Utilities, government agencies, and consumer groups face a difficult problem in motivating individuals to conserve water when there is not an immediate crisis. Studies have shown that the installation of individual water meters reduces residential consumption, and it may be possible to use the water meter as a feedback device. Pricing systems, such as increasing block rate, and peak load or seasonal rates, are possible methods of encouraging conservation, but they have not yet been fully tested. (Moore-SRC)
W81-05740

**WATER CONSERVATION TECHNIQUES AND EXPERIENCES,**
Massachusetts Water and Sewer Commission, Boston.
J. P. Sullivan Jr.
Journal of the New England Water Works Association, Vol 94, No 1, p 52-54, March, 1980.

Descriptors: *Water conservation, *Water metering, *Leakage, Water rates, Conservation, Municipal water, Surveys, Water distribution, *Boston, Massachusetts.

The experiences of the City of Boston in its efforts to conserve water and reduce its percentage of unaccounted-for water are presented. To reduce unaccounted-for water, the city increased its rate of industrial water meter replacement and upgraded its method for leakage detection. To encourage water conservation, flat rate billing was established, which increased small users' bills by 16.6% and largest users' bills by as much as 90%. Also, the City of Boston is now billed for water used by city departments. These steps remind users that water is not cheap and plentiful. New automatic meters are being installed, and a meter testing program has been initiated. Consumption dropped from 150 MGD in 1975 to 146 MGD in 1976. Total percent of accounted-for water is 57%. The percentage of accounted-for water is increasing and should continue to do so with increased metering and leakage surveys. (Small-FRC)
W81-05826

**CONSERVATION OF WATER WITH REFERENCE TO THE INTERNATIONAL WATER SUPPLY AND SANITATION DECADE,**
National Environmental Engineering Research Inst., Nagpur (India).
V. Raman.
Aqua, No 2, p 28-32, 1980. 2 Tab, 21 Ref.

Descriptors: *Water conservation, *Water loss, *Leakage, *India, Water reuse, Water supply, Drinking water, Evaporation control, Seepage control, Domestic water, Irrigation water, Water quality, Water pollution control, Pipes, Water distribution, Water treatment facilities, Water supply systems, Canals, Reservoirs, Wastewater renovation.

Proper management of domestic water supply systems in India with respect to quality and quantity is discussed in reference to the objectives of the International Water Supply and Sanitation Decade. Wastage often amounts to 30-40% of the flow in the system. Leakage can occur at many places--storage facilities, pipes and joints, excessive consumption, etc. Proper maintenance can reduce this wastage and improve water quality. A table shows the percentage reductions in waste flow (41 to 94%) produced by control programs in seven Indian cities. Backwashing filters in treatment plants are another source of waste, and careful control of this process can keep wastage to 5%. Reservoirs and canals, which lose water by evaporation and seepage, can be made to retain more water by covering surfaces with cetyl alcohol and other evaporation barriers and by lining the structures with plastic or cement. Water conservation in the home may include tubs, toilets, and showers with reduced capacity and flow and reducing the number of taps per household. However, conservation measures should not adversely affect public health. Water, particularly domestic wastewater effluent, can be reused for irrigation and industry. (Cassar-FRC)
W81-06039

## 3E. Conservation In Industry

**STUDY FAVORS OXYGEN BLEACHING OVER BIOLOGICAL TREATMENT PLANT,**
L. Almberg, A. Jamieson, and S. Waldestam.
Canadian Pulp and paper Industry, Vol. 33, No. 1, p 26-27, 29-30, January, 1980. 4 Fig, 6 Tab, 4 Ref.

Descriptors: *Pulp and paper industry, *Oxygen bleaching, Industrial wastewater, Biological treatment, Chemical oxygen demand, Water pollution control.

A survey of the economics of pollution abatement in kraft pulp mills compared oxygen bleaching and biological treatment processes specifically considering investments of about $7.5 million. Using oxygen bleaching as a means of reducing water pollution involves integration of the oxygen stage into the washing system for unbleached pulp. This process permits recycling of the dissolved lignin to the mill's normal recovery system and significantly reduces the demand for bleached chemicals. Compared with biological wastewater treatment processes, installation of an oxygen stage requires less capital, makes the mill less dependent on energy price and availability, and offers greater reductions in chemical oxygen demand, color, and chlorinated-lignin quantities. In addition, the addition of the oxygen bleached process results in a reduction in total running costs by reducing chemical costs, water usage, and capital investment costs. (Carroll-FRC)
W81-05938

## 3F. Conservation In Agriculture

**MODELING CROP RESPONSE FOR ECONOMIC WATER USE AND FOR WATER CONSERVATION,**
Kansas Water Resources Research Inst., Manhattan.
A. W. Biere, E. T. Kanemasu, and E. S. Lee.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108473, Price codes: A03 in paper copy, A01 in microfiche. Project Completion Report, May, 1981. 41 p, 11 Fig, 4 Tab, 16 Ref, 2 Append. OWRT-A-086-KAN(4), 14-34-0001-7036.

Descriptors: *Crop yields, Limited irrigation, Dynamic crop response, *Corn, Evapotranspiration, Crop growth, Plant growth, Soil water, *Soil-water-plant relationships, *Irrigation-return flow, *Crop yields, Energy prices, Pump lift, Given economic conditions.

A dynamic model of corn yield response to daily available soil moisture is presented. Using a priori information on dry matter accumulation in the plant when water is not limiting, and when using spline regression, we estimate the function of crop response to soil moisture from experimental test plot data. Using other data, we test the validity of the estimated mode. With the estimated model we simulate the corn yields for various irrigation schedules. The simulations demonstrate the sensitivity of the model to the timing of irrigations. The dynamic crop response model is incorporated into a dynamic programming model to obtain the opti-

mal irrigation schedule. As economic conditions change, the optimal schedule changes. The optimal schedules (number and time or irrigations) under various price and cost conditions are obtained. The effects of pumping lift and energy prices on the optimal schedule and the returns to irrigation are examined.
W81-05703

**IRRIGATION SYSTEM AND FLUID DISPERSION NOZZLE,**
Eaton Corp., Cleveland, OH. (Assignee).
J. P. Varner.
U.S. Patent No 4,228,956, 6 p, 6 Fig, 6 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1009-1010. October 21, 1980.

Descriptors: *Patents, *Irrigation systems, *sprinkler irrigation, *Application equipment, Nozzles, Irrigation efficiency, Irrigation practices, Flow control.

A substantially uniform water distribution pattern is achieved without the need for additional structural elements external to the sprinkler nozzle for breaking up the flow stream. Radially inwardly projecting lugs located on the outer periphery of the sprinkler nozzle orifice serve to deflect a portion of the water stream, thus permitting a significant amount of water to be uniformly dispersed along the entire length of the water stream. A further feature includes the utilization of a resilient flow control element which limits the flow rate through the sprinkler nozzle to a predetermined magnitude and controls the diameter of the resultant flow stream within a predetermined range. The flow control element permits the deflecting lugs to uniformly disperse fluid flow over a range of varying supply pressures. The invention is also embodied as a sprinkler irrigation system which incorporates the features of the fluid dispersion nozzle. The impulse arm and its associated hardware are replaced by a far simpler water turbine drive mounted directly within the sprinkler head member. (Sinha-OEIS)
W81-05786

**SAFETY DEVICE FOR MOBILE IRRIGATION ASSEMBLIES,**
L. F. Petersen.
U.S. Patent No 4,228,955, 5 p, 4 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1009. October 21, 1980.

Descriptors: *Patents, *Irrigation systems, *Irrigation operation and maintenance, Irrigation efficiency, Automatic control, Safety, Application equipment.

An object of the present invention is the provision of a mobile irrigation safety device which is simple to manufacture and install, and which provides a positive stopping control over the irrigator. The safety device, which is operable by contact with a separate ground engaging means, stops the movement of the irrigator when it approaches within a predetermined distance of an obstruction. The device permits the operator of a mobile irrigator to allow the system to run unattended without fear of the irrigator deviation from a predetermined arc segment and will allow the irrigator to travel in either a clockwise or counterclockwise direction for a predetermined distance. (Sinha-OEIS)
W81-05787

**CENTER PIVOT IRRIGATION SYSTEM HAVING APPARATUS FOR IRRIGATING CORNERS,**
Lockwood Corp., Gering, NE. (Assignee).
H. L. Holloway, and E. M. Norum, Jr.
U.S. Patent No 4,227,648, 15 p, 7 Fig, 2 Tab, 15 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 568. October 14, 1980.

Descriptors: *Patents, *Irrigation, *Irrigation systems, *Sprinkler irrigation, *Control systems, Automatic control, electronic equipment, Irrigation efficiency, Application equipment, Nozzles.

A center pivot irrigation system has first and second auxiliary nozzles, or end guns, alternately operable for irrigating substantial portions of corner regions. The system includes a main pipeline sprinkler having main fluid discharge nozzles for irrigating a central, generally circular area, and the end guns are connected to the main pipeline sprinkler and draw irrigation fluid from it. When a corner is approached, one of the end guns is actuated while maintaining actuation of the main fluid discharge nozzles. A short period of time thereafter, the second end gun is actuated, and the pivotal rate of the main pipeline sprinkler is reduced to zero. At this time the main fluid discharge nozzles and the first end gun are closed, thereby providing all of the fluid from the main pipeline sprinkler to the operating end gun. After a predetermined time period, the second end gun is inactivated, the first gun and the main nozzles are reactivated, and the system is pivoted to a new orientation. After several such sequences and the corner has been passed, only the main nozzles are actuated until another corner is approached. Timers are provided for determining the duration of the periods during which the irrigation fluid is being discharged through the various nozzles, thereby allowing effective control of the amount of irrigation fluid discharged. (Sinha-OEIS)
W81-05795

**WELL-EFFICIENCY PROJECT YIELDS ENERGY-SAVING DATA,**
For primary bibliographic entry see Field 8A.
W81-05883

**SPRINKLERIRRIGATION RAISES YIELDS - AND COSTS - OF IMPERIAL VALLEY ALFALFA,**
Science and Education Administration, Brawley, CA.
R. W. Hagemann, and C. F. Ehlig.
California Agriculture, Vol. 34, No. 1, p 8-9, January, 1980. 1 Tab.

Descriptors: *Sprinkler irrigation, *Costs, *Alfalfa, Crop yield, Irrigation, Crop production, Flood irrigation, *Imperial Valley, California.

Yield and cost were compared for sideroll-sprinkler and border-flood irrigation systems in tests conducted at a farmer-operated alfalfa field. Water applications and hay yields were measured between November 1976 and April 1978. Costs of laobr, electricity, and custom harvest were recorded. Sprinkler irrigation has a yield advantage of one ton/acre and a water saving of one acre-foot/acre, but these advantages were offset by higher costs. Net profit was much higher for border flood irrigation than for operator owned sideroll sprinklers, and rented sprinklers were not at all profitable. soil salinity and phosphorus content were similar under both irrigation systems. Further study is needed to determine whether yield differences will continue and to determine possible differences in stand life, root and foliar disease, and hay quality as a function of irrigation method. (Small - FRC)
W81-05885

**WATER DISTRIBUTION UNIFORMITY OF UNDERTREE SPRINKLERS IN HIGH DENSITY ORCHARDS,**
Department of Agriculture, Summerland (British Columbia). Research Station.
P. Parchomchuk, and D. S. Stevenson.
Transactions of the ASAE, Vol 23, No 1, p 88-91. January/February, 1980. 1 Fig, 6 Tab, 4 Ref.

Descriptors: *Orchards, *Sprinkler irrigation, Irrigation, Irrigation efficiency, Sprinklers, Sprinkling, Nozzles, Water distribution.

Water distribution uniformity of solid set undertree sprinklers in high density hedgerow orchard plantings was investigated. Uniformities of four commonly used undertree orchard sprinklers in 3.7, 4.6, and 5.5 meter row spacings were measured for several sprinkler spacings and nozzle angles. These were compared with uniformities measured in an open area where there was no nozzle stream interference. Interception of the nozzle stream by tree foliage resulted in heavier precipitation beneath trees than in the area between tree rows. Uniformity coefficient in the area along tree rows was up to 27% higher than overall uniformity in the basic pattern area. Triangle sprinkler arrangements gave better uniformity than an equivalent rectangular pattern. Except at very close tree row spacing, uniformity in the area along tree rows was equivalent to that of unimpeded sprinklers. Sprinkler spacing was not critical so long as a certain distance was not exceeded. Uniformity decreased as nozzle angle increased. With proper selection of nozzle angle and sprinkler spacing, only areas along tree rows could be selectively irrigated to conserve water. (Baker-FRC)
W81-05914

**MATHEMATICAL MODEL OF BORDER IRRIGATION,**
Harza Engineering Co., Chicago, IL.
D. W. Fonken, T. Carmody, E. M. Laursen, and D. D. Fangmeier.
Journal of the Irrigation and Drainage Division, Proceedings of the America Society of Civil Engineers, Vol 106, No IR3, p 203-220, September, 1980. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Border irrigation, *Irrigation engineering, Infiltration, Model studies, Mathematical models, Computers, Hydraulics, Hydrodynamics.

Border irrigation uses a broad, shallow sheet of water flowing between two dikes from the upper end of the border to the lower end. A complete hydrodynamic model of all phases of border irrigation can predict the rates of advance and recession and the duration and depth of infiltration at any point in a border. Through this model, the optimum combination of discharge rates and inflow duration can be found. Five major variables are used: discharge, infiltration, slope, roughness, and length. The model is an inexpensive ($1.70 per run) alternate to the Bassett and the Katopodes and Strelkoff models. Equations satisfying the laws of conservation of mass and momentum are applied to a control volume over a finite period of time. Numerical integration is accomplished by selecting quantities of time and space that are finite, but small enough so that average values can be used to represent the range of values actually occurring over the interval. The model was validated using field data from the University of Arizona. Advance times were within 3-20%, recession times within 1.8-2.5%, and flow depths to 13%. (Cassar-FRC)
W81-05919

**DESIGN OF A FARM LAYOUT FOR IRRIGATION WITH LIMITED DISCHARGES,**
Central Soil Salinity Research Inst., Karnal (India).
V. V. Dhruva Narayana, V. D. Kalra, and O. P. Singh.
Agricultural Water Management, Vol 3, No 2, p 143-151, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Irrigation efficiency, *Water conservation, *Irrigation design, Irrigation water, Mathematical studies, Infiltraton, Soil water, *Irrigation wells, Water supply, On-site tests, Irrigation practices, Field tests, *Small farms, India.

A study was conducted at the Central Soil Salinity Research Institute of Karnal, India, in an attempt to improve the irrigation efficiencies of small farms that use cavity wells for their water supply. Such cavity wells lack discharge regulating devices to enhance the efficiency of irrigation. An irrigation layout was designed to provide uniform water application. Field determinations were made of the opportunity time at each point along the border from advance and recession curves, and the depth of cumulative infiltration was computed from infiltration rate curves. Irrigation efficiencies were calculated from results of soil moisture tests conducted before and after each irrigation. The present method overestimates the irrigation efficiencies due to the empirical nature of the infiltration equation. For small farms with discharge of 10 liters/sec the recommended borders for irrigation layout are 50-70 m in length and 6-8 m in width. (Geiger-FRC)
W81-06008

**WATER USE IN LOWLAND RICE CULTIVATION IN ASIA: A REVIEW OF EVAPOTRANSPIRATION,**
Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
V. S. Tomar, and J. C. O'Toole.
Agricultural Water Management, Vol 3, No 2, p 83-106, 1980. 5 Fig, 4 Tab, 22 Ref.

Descriptors: *Literature reviews, *Irrigation practices, *Evapotranspiration, Crop yield, Evaporation, Transpiration, Rice, Reviews, Crop production, Model studies, Mathematical studies, Wetlands, Asia.

The literature on transpiration, evaporation and the ratio of actual evapotranspiration to open pan evaporation (ET/EP), along with the basic principles which influence these events in wetland rice cultures of South and Southeast Asia are reviewed. A simple model is proposed to predict evapotranspiration from wetland rice based on available information from previous research. Different regions exhibit large variations in seasonal as well as daily total transpiration and evapotranspiration values. At early stages of growth, crop transpiration rate is low, but it increases almost linearly, reaching 3-4 mm/day at the maximum tiller number stage and 5-7 mm/day at heading time. Similar patterns occur for evapotranspiration, with variations occurring with crop growth stages. Seasonal average evapotranspiration ranges from 4 to 7 mm/day, while the value of the crop growth coefficient factor is 1 at transplanting and 1.15 at maximum tiller number stage. At the flowering stage, ET/EP is about 1.3, and for a crop season this ratio is approximately 1.2. It is suggested that this data will be useful in developing better water management practices for the cultivation of wetland rice crops. (Geiger-FRC)
W81-06009

# 4. WATER QUANTITY MANAGEMENT AND CONTROL

## 4A. Control Of Water On The Surface

**PREIMPOUNDMENT WATER QUALITY IN THE TIOGA RIVER BASIN, PENNSYLVANIA AND NEW YORK,**
Geological Survey, Harrisburg, PA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W81-05711

**CHARACTERIZATION OF FLOODFLOWS ALONG THE ARKANSAS RIVER WITHOUT REGULATION BY PUEBLO RESERVOIR, PORTLAND TO JOHN MARTIN RESERVOIR, SOUTHEASTERN COLORADO,**
Geological Survey, Lakewood, CO. Water Resources Div.
J. R. Little, and D. P. Bauer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-216632, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-97, 1981. 36 p, 11 Fig, 13 Tab, 7 Ref.

Descriptors: *Flood flow, *Streamflow forecasting, *Water management, Diversion, Aquifer characteristics, Surface-groundwater relations, Flow control, *Flood routing, Computer models, Regression analysis, *Colorado, Arkansas Rive, John Martin Reservoir.

The need for a method for estimating flow characteristics of flood hydrographs between Portland, Colo., and John Martin Reservoir has been promoted with the construction of the Pueble Reservoir. To meet this need a procedure was developed for predicting floodflow peaks, traveltimes, and volumes at any point along the Arkansas River between Portland and John Martin Reservoir without considering the existing Pueble Reservoir detention effects. A streamflow-routing model was calibrated initially and then typical flood simulations were made for the 164.8-mile study reach. Simulations were completed for varying magnitudes of floods and antecedent streamflow conditions. Multiple regression techniques were then used with simulation results as input to provide predictive relationships for food peak, volume, and traveltime. Management practices that may be used to benefit water users in the area include providing methods for the distribution and allotment of the flood waters upstream of Portland to different downstream water users according to Colorado water law and also under the Arkansas River Compact. (USGS)
W81-05730

**ESTIMATING PROBABILITIES OF RESERVOIR STORAGE FOR THE UPPER DELAWARE RIVER BASIN,**
Geological Survey, Reston, VA. Water Resources Div.
R. M. Hirsch.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $2.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-478, June, 1981. 18 p, 1 Ref.

Descriptors: *Forecasting, *Water supply, *Reservoirs, *Reservoir storage, Drought, Simulation analysis, Model studies, Available water, Risks, Planning, *Upper Delaware River basin, *New York City, Position analysis.

A technique for estimating conditional probabilities of reservoir system storage is described and applied to the upper Delaware River Basin. The results indicate that there is a 73 percent probability that the three major New York City reservoirs (Pepacton, Cannonsville, and Neversink) would be full by June 1, 1981, and only a 9 percent probability that storage would return to the 'drought warning' sector of the operations curve sometime in the next year. In contrast, if restrictions are lifted and there is an immediate return to normal operating policies, the probability of the reservoir system being full by June 1 is 37 percent and the probability that storage would return to the 'drought warning' sector in the next year is 30 percent. (USGS)
W81-05737

**EFFECT OF NAVIGATION DAMS ON BANKS OF OHIO RIVER,**
W. H. Browne.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 443-461, 8 Fig.

Descriptors: *Bank erosion, *Navigation, *Locks, *Rivers, *Water level fluctuations, Eddies, *Ohio River, Land use, Stream banks, Flood damage, Wave wash, Surface runoff, Riparian land.

During the past 10 years numerous complaints have been received from riparian landowners along the Ohio River which contend that construction and operation of the modern highlift navigation structures have accelerated failures of the streambanks. There are several mechanisms that could be responsible for bank failures, acting either separately or in various combinations, such as: river currents; river eddies; propeller wash; changes in land; waves; rapid lowering of water surface; piping of layers of impervious materials; surface runoff; and colluvial slides. A bank erosion study was initiated to develop and analyze technical and historical data to arrive at a professional and documented conclusion as to whether raising the pools upstream of the navigation structures was a cause of bank failure. The study concluded that bank erosion would have occurred along the Ohio River, including tracts under litigation, by natural phenomena without the construction of navigational structures and the impoundment of permanent pools. Of these phenomena the most significant erosion causative factors are failure of the bank during and following wet periods and the reworking and transport of slumpage debris. Significant erosion conditions and bank failure following floods have been noted in historic records. Ohio River navigation structures have been constructed throughout the past 100 years and conditions of moderate to severe erosion have been noted within all reaches regardless of the period of impoundment. (Moore-SRC)
W81-05751

**EVALUATION OF HYDRAULIC GEOMETRY PARAMETERS FOR VARIOUS LOW-FLOW RELEASES DOWNSTREAM OF DAMS ON ILLINOIS STREAMS,**
Illinois State Water Survey Div., Champaign.
K. Singh.
SWS Contract Report No 251, April, 1981. 42 p, 4 Tab, 3 Ref.

Descriptors: *Hydraulic geometry, Parameter hydrology, Flow velocity, Flow duration, *Low flow, Public waters, Dams, Flow rates, Flow discharge, Reservoirs, Gaging stations, Economic aspects, Instream flow, *Low-flow augmentation, *Illinois, *Reservoir releases.

State, local and corporate water planning often presumes that all water in a stream is potentially available for off-stream uses; however, this assumption clearly contradicts legislative mandates regarding the public interest in preserving water for instream flow uses, such as for water quality and aquatic organisms, fish and wildlife. The regulatory and institutional solutions to this problem require the development of hydraulic geometry parameters (area of flow section, mean flow velocity, top width of flow section, and mean depth of flow section) for different flow releases from the reservoirs and the assessment of economic and instream-flow-need impacts for various flow releases considered. Criteria considered in evaluating economic and other impacts for mandating a particular low-flow release from an impounding reservoir included data from 229 gaging stations in Illinois and eight low-flow release levels. The hydraulic geometry relations were significantly improved by dividing the Sangamon basin into three sub-basins on the basis of flow duration and by making a few changes in the equation structure. Extensive tables are included that display values of the parameters for each flow release at 123 gaging stations. These stations were chosen after an evaluation process that eliminated four from a selection of 127 because the relevant data were too old. (Garrison-Omniplan)
W81-05799

**LONG-MEMORY FLOW MODELS IN RESERVOIR ANALYSIS: WHAT IS THEIR PRACTICAL VALUE,**
National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes, R. Srikanthan, and T. A. McMahon.
Water Resources Research, Vol 17, No 3, p 737-751, June, 1981. 4 Fig, 5 Tab, 35 Ref.

Descriptors: *Streamflow forecasting, *Reservoir storage *Reservoir operation, *Model studies, Stochastic process, Flow control, Elbe River, Czechoslovakia, St. Marys River, Ontario, Statistical analysis, Social aspects, Economic aspects.

Long-memory stochastic models, developed over the past 15 years to improve reservoir analyses, offered little advantage over short-memory models in applications to two rivers, the Elbe in Czechoslovakia and St. Marys, Sault Ste. Marie, Ontario. The reduction of the safety factor due to use of the long-memory model was small compared with the accuracy of measurement of the socioeconomic impact of reliability changes and with the accuracy of estimating the reliability itself on the basis of available streamflow records, for economically relevant lengths of reservoir operation periods. Thus replacement of short-memory models is unjustified. (Cassar-FRC)
W81-05822

**STORMWATER DETENTION BASIN SIZING,**
MHM Inc., Marysville, CA.
For primary bibliographic entry see Field 2E.
W81-05895

**MODEL FOR THE OPTIMAL PLANNING OF STRUCTURAL FLOOD CONTROL SYSTEMS,**
Natal Univ., Durban (South Africa). Dept. of Civil Engineering.
J. S. Windsor.
Water Resources Research, Vol 17, No 2, p 289-292, April, 1981. 2 Fig, 5 Ref.

Descriptors: *Flood control, *Model studies, Mathematical models, Flood protection, Floodproofing, Computers, Planning, *Design criteria.

A method is proposed for the planning and design of composite multiunit flood control structures, where the objective is to minimize total system cost. The method of solution involves modifications of linear programming known as separable and mixed integer programming. These techniques treat the system as an integrated unit and have the advantage of being able to cope with nonlinear, discontinuous, and discrete cost functions that may arise in practical situations. The feasibility of the method enables a large number of alternative configurations to be considered simultaneously, even though they may be at different stages of planning. A variety of criteria and basic input data can also be examined with relatively simple adjustments in the program. (Baker-FRC)
W81-05952

**RIPARIAN MANAGEMENT: A FLOOD CONTROL PERSPECTIVE,**
Arizona State Univ., Tempe. Dept. of Geography.
W. L. Graf.
Journal of Soil and Water Conservation, Vol 35, No 4, p 158-161, July/August, 1980. 4 Fig, 31 Ref.

Descriptors: *Flood control, *Riparian vegetation, Riparian land, *Riparian waters, Vegetation, Flood protection, Flood routing, Economic aspects.

The need for flood control brings problems to those faced with the management of riparian environments. First, there is the question of whether the vegetation along the river and channel banks should be cleared while it is considered to be a valuable habitat for wildlife. Second, if clearing is to be done, how can it be best accomplished. Settlement of the southwest by farmers, ranchers, and miners brought about drastic changes in the riparian areas. Government agencies and private property owners have three management alternatives in dealing with flood control/phreatophyte growth problems. First there is the no-action alternative. Second is clearing and maintaining. Third is to restore the areas to their nearly original conditions. Clearing and maintaining would involve limited clearing operations to clear floodways through the riparian zone. Plowing, discing, chaining, and burning have been used in some cases, with varying degrees of success. Use of bulldozer blade and root rake has been the most successful. Herbicides do retard undesired regrowth of vegetation, but carry with them other risks including the potential of carcinogenic action. Some attention is given to the costs of action vs. the costs of non-action in the control of floodwaters along riparian routes. (Baker-FRC)
W81-05990

## 4B. Groundwater Management

**MODELING CROP RESPONSE FOR ECONOMIC WATER USE AND FOR WATER CONSERVATION,**
Kansas Water Resources Research Inst., Manhattan.
For primary bibliographic entry see Field 3F.
W81-05703

**ESTIMATED PUMPAGE FROM GROUNDWATER SOURCES FOR PUBLIC SUPPLY AND RURAL DOMESTIC USE IN FLORIDA, 1977,**
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05724

**ECONOMIC CONSEQUENCES OF LAND SURFACE SUBSIDENCE,**
Goleta Water District, CA.
L. C. Fowler.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol. 107, No. IR2, p151-159, June, 1981. 1 Tab, 7 Fig, 2 Ref.

Descriptors: *Economic aspects, *Subsidence, *Storage capacity, *Water supply, *Aquifers, Sediment load, Soil properties, Alluvium, Hydraulic properties, Flood protection, Flood control, Drainage, Groundwater storage, Cost analysis, *Santa Clara Valley, California.

Subsidence of the Santa Clara Valley is caused by the overdraft and the resulting decline of the artesian pressure head in the groundwater basin. Importation of water through an aqueduct eliminated the groundwater overdraft, increased the artesian pressures, and raised groundwater levels. since 1969, no significant subsidence has occurred. Costs of repair damages resulting from subsidence have been reduced. Importation of water is an essential aspect of water supply planning in this area. (Titus-FRC)
W81-05802

## 4C. Effects On Water Of Man's Non-Water Activities

**STORM RUNOFF AS RELATED TO URBANIZATION IN THE PORTLAND, OREGON - VANCOUVER, WASHINGTON AREA,**
Geological Survey, Portland, OR. Water Resources Div.
A. Laenen.
Geological Survey Open-File Report 80-689 (WRI), 1980. 71 p, 17 fig, 1 Plate, 14 Tab, 18 Ref.

Descriptors: *Storm runoff, *Rainfall-runoff relationships, *Urbanization, *Oregon, *Washington, Watersheds, Regional analysis, Data collections, Mathematical models, Simulation analysis, Flood frequency, Frequency analysis, Land use, Parametric hydrology. Portland-Vancouver areas, Basin characteristics, Flood peak, Flood forecasting, Regression analysis.

A series of equations was developed by regression analysis to provide a method for determining flood frequencies for both peak discharge and storm runoff in the Portland-Vancouver area of Oregon and Washington. Sensitivity analysis indicates a totally developed urban basin in this area would have peak discharges three times greater than when it was undeveloped. Land uses of parks, forests, vacant lots, and agriculture are an excellent inverse indication of urbanization. Those uses, coupled with the street-gutter density in a basin, provide a practical alternative to defining the effective impervious area. Storage area in a basin, as defined by surface area of lakes, ponds, marshes, flood plans, depressions, and detention facilities, proved to be a highlysignificant parameter for determining peak flow. (USGS)
W81-05713

**EFFECTS OF URBANIZATION ON THE MAGNITUDE AND FREQUENCY OF FLOODS ON SMALL STREAMS IN TENNESSEE - BASIC DATA REPORT NO. 1,**
Geological Survey, Nashville, TN. Water Resources Div.
F. N. Lee.
Geological Survey Open-File Report 80-572, June, 1980. 21 p, 1 Fig.

Descriptors: *Floods, *Urbanization, *Storm runoff, *Small watersheds, *Tennessee, Flood frequency, Flood recurrance interval, Hydrologic data, Gaging stations, Sites, Flood peak, Flood stages, Urban watersheds.

Peak stages and discharges recorded at 17 gaging stations on streams draining small (less than 20 sq mi) urbanized basins across Tennessee are presented. Sites gaged are in 17 different municipaities with population range between 5,000 and 100.000. The report gives a description of each gaged site along with a data sheet in which peak stages and discharges above a selected base are listed. The description gives the station location, type of gage, records available, basin parameters and general remarks. (USGS)
W81-05715

**ANALYZING FLOODPLAIN POLICIES USING AN INTERDEPENDENT LAND USE ALLOCATION MODEL,**
Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture.
L. D. Hopkins, E. D. Brill Jr., K. B. Kurtz, and H. G. Wenzel Jr.
Water Resources Research, Vol 17, No 3, p 469-477, June, 1981. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Land use, *Flood plain management, *Urban planning, Detention reservoirs, Model studies, Water policy, Hickory Creek, Illinois, Economic aspects, Planning, Urban watersheds, Storm water, Urban runoff, Regulations, Flow control.

A model is used to compare allocations of land uses in terms of aggregate economic rent, accounting for the interdependence of flood plain land uses and upstream land uses. The Hickory Creek watershed, Illinois, area 109.8 sq miles, was chosen for demonstrating the model because substantial development is expected in the upper reaches in the near future. For this situation the best solution was some reduction of land uses in the flood plain, but not for all of the 67 subbasins, and some provision of detention, but not for all subbasins. (Cassar-FRC)
W81-05817

**FRESHWATER WETLAND DYNAMICS IN SOUTH KINGSTOWN, RHODE ISLAND, 1939-1972,**
Rhode Island Univ., Kingston. Dept. of Forest and Wildlife Management.
F. C. Golet, and J. A. Parkhurst.
Environmental Management, Vol 5, No 3, p 245-251, May, 1981. 2 Fig, 3 Tab, 26 Ref.

Descriptors: *Wetlands, *Environmental effects, *Land development, *Wildlife management, Succession, *Rhode Island, Marshes, Swamps, Highway effects, Vegetation.

Changes in the freshwater wetlands near South Kingstown, Rhode Island, were determined by field work and by analysis of panchromatic aerial photographs taken in 1939 and 1972. During this period the total area of freshwater wetlands decreased from 2345.2 ha to 2324.4 ha (0.9% loss), mostly from highway construction and residential development. Wooded swamp and shrub swamp accounted for 87.6% of the area in 1939 and 88.7% in 1972. Approximately 17% or 407.4 ha of 1939 wetlands changed to different classifications by 1972. 57% was caused by plant succession and 41$ by man's activities. Man's major role in the area was to alter the water regimes and vegetational composition of the wetlands, producing gains in open water and deep marsh and losses in shallow marsh, meadow, and evergreen wooded swamp. Plant succession was responsible for most of the changes between 1939 and 1972. Most changes followed the progressive pattern, toward wooded swamp from shallow marsh, meadows, and shrub swamp. The study concluded that the freshwater wetlands of southern New England are very dynamic, the wooded swamp is dominant and still increasing in area, and vegetational changes from natural succession dominate man's impact. Wildlife diversity has decreased along with decreasing wetland diversity. Knowledge of wetland dynamics is essential for management of wetlands for wildlife, recreational, and esthetic purposes. (Cassar-FRC)
W81-05880

**UNSTEADY FLOW COMPUTATION FOR FULL STORM SEWER,**
Geological Survey, Austin, TX.
L. F. Land, and H. E. Jobson.

Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY8, p 1389-1393. August, 1980. 3 Fig, 4 Ref.

Descriptors: *Storm runoff, *Flow characteristics, *Urban watersheds, *Storm sewers, Storm drains, Sewers, Storm water, Urban runoff, Urban areas, Urban drainage, Model studies.

An investigation was made to characterize storm-water runoff from small urban watersheds in Broward and Dade Counties, Florida, using runoff monitoring sites. At three sites the discharge was determined through use of a laboratory calibrated U-shaped constriction inserted into the storm sewer. At a fourth site the existing hydraulic system was used. After monitoring several storms it was determined that the water-level measurements had to be more accurate than the monitoring equipment could provide to compute accurate discharges at low flow. The rapid flow changes also caused the assumptions needed for the application of the steady-flow equation to be suspect for the fourth site. After corrections had been made, an unsteady flow model incorporating basic transient pipe-flow equations was used. This model, formulated to simulate flow in the storm sewer, is described, and the computed discharges compared with discharges measured using the velocity meter. This modeling technique is believed to offer an advantage over a steady-flow equation, as dynamics of the flow system are better represented. (Baker-FRC)
W81-05918

## UNIT HYDROGRAPHS FOR URBANIZING WATERSHEDS,

Army Engineer District, Charleston, SC.
J. F. Cruise, and D. N. Contractor.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY3, p 440-445. March, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Model studies, *Urban runoff, *Unit hydrographs, Hydrography, Watersheds, Water resources development, Urban watersheds, Urbanization.

The usefulness of the unit hydrograph model for an urbanized watershed was tested. Urbanization of a watershed is often an important factor in designing a water resources project, as development of an area can increase flood flows. The model seemed sufficiently sensitive to changes in urban development to be useful to cities in projecting future runoff. Factors reflecting other urban characteristics such as percentage of channels improved and location and type of development within the basin could be incorporated into this relatively simple model. This procedure was more successful than other synthetic unit graph procedures in providing for the effects of urban development. A complete unit hydrograph is computed by the model. The unit hydrographs from two storms and the unit hydrograph predicted by the model were compared, and close agreement was found. (Small-FRC)
W81-05921

# 4D. Watershed Protection

## CLEARCUTTING PATTERNS AFFECT NITRATE AND CALCIUM IN STREAMS OF NEW HAMPSHIRE,

Northeastern Forest Experiment Station, Durham, NH.
C. W. Martin, and R. S. Pierce.
Journal of Forestry, Vol 78, No 5, p 268-272, May, 1980. 1 Fig, 1 Tab, 18 Ref.

Descriptors: *Clear-cutting, *Nitrates, *Calcium, *Erosion control, Logging, Soil erosion, Erosion, Stream degradation, Water quality, Watershed management, Nutrients, New Hampshire, Runoff, Pollution load.

Data are presented on nitrate and calcium ion concentrations in streams draining clearcuttings of various sizes and configurations in the White Mountains of New Hampshire. Streams draining seven forested watersheds had average annual nitrate and calcium concentrations of about 1.8 plus or minus 1.0 mg/liter. Streams from nine watersheds that were clearcut had nitrate concentrations that rose to a maximum of 25.1 plus or minus 4.2 mg/liter. Maximums occurred during the second year after cutting, and both nutrients returned to reference levels about five years after cutting. A wide range of nutrient concentrations was found in streams draining seven partially clearcut watersheds. The magnitude and duration of increases in nutrient concentrations were reduced when buffer strips were left along the stream of partially clearcut watersheds. Progressive strip cutting with a buffer strip caused the least increase. (Small-FRC)
W81-05984

## LOGGING, INFILTRATION CAPACITY, AND SURFACE ERODIBILITY IN WESTERN OREGON,

Coconino National Forest, Flagstaff, AZ.
M. G. Johnson, and R. L. Beschta.
Journal of Forestry, Vol 78, No 6, p 334-337, June, 1980. 4 Fig, 6 Ref.

Descriptors: *Logging, *Clear-cutting, *Soil erosion, Water quality, Infiltration capacity, Watershed management, Oregon, *Erosion control.

Infiltration capacity and erodibility were determined for a partially logged watershed three to six years after logging. Four continuous experimental watersheds ranging from 128 to 171 acres were studied. Overall values for the logged portions did not differ significantly from values for the unlogged portions. The study was not begun immediately after logging, so if logging did influence infiltration capacity and erodibility, the effects had almost disappeared by the study time. Where soils had been severely compacted, the surface layer removed, or logging slash burned with fire, infiltration capacity was reduced and erodibility was greater than in unlogged areas. The effects of logging can be minimized by using cables instead of tractors for log pulling, by restricting the area in skid trails, and by broadcast burning of slash instead of windrowing. Prevention of undue soil disturbance will conserve site productivity and help minimize downstream problems of water quality. (Small-FRC)
W81-05985

## COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,

Idaho Univ., Moscow. Dept. of Agricultural Economics.
D. J. Walker, and J. F. Timmons.
Journal of Soil and Water Conservation, Vol 35, No 4, p 177-183, July/August, 1980. 1 Fig, 5 Tab, 20 Ref.

Descriptors: *Soil erosion, *Sediment discharge, Erosion, Sedimentation, Soils, Agricultural runoff, Agricultural engineering, planning, *Erosion control, Legal aspects, Soil loss tax.

Twelve policy simulations were evaluated to determine their effectiveness in reducing erosion and sediment discharge from agricultural land. These simulations included: a ban on fall moldboard plowing, and annual soil loss limit of five tons per acre, a ban on straight-row cultivation on slopes over 2%, a soil loss tax, a subsidy for contouring, a subsidy for minimum tillage and a combination of these last two policies, bans on fall plowing and straight-row cultivation, a soil loss tax with a ban on fall plowing, a subsidy for contouring with a ban on fall plowing, a subsidy for minimum tillage with a ban on fall plowing, and combined subsidies on minimum tillage and contouring in addition to the base run. Three of these policies were capable of reducing soil loss and associated stream sedimentation by 50%. These three were a ban on fall plowing, a soil loss tax of ten cents to 20 cents per ton, and a subsidy for minimum tillage. The ban on fall plowing and the soil loss tax entailed income penalties varying from two to three percent, depending on the price scenario. Reductions in soil loss and sedimentation up to 90% were possible with more restrictive policies. A dual ban on fall plowing and straight-row cultivation on slopes, an annual soil loss limit of five tons per acre, and a soil loss tax of between 50 cents and $1.50 per ton achieved these reductions in soil loss. All resulted in an income penalty of less than 14%. The most cost-effective policy in this group was the dual ban on fall plowing and straight-row cultivation on slopes. (Baker-FRC)
W81-05987

# 5. WATER QUALITY MANAGEMENT AND PROTECTION

# 5A. Identification Of Pollutants

## EXTRACTION AND ANALYSIS OF ADENOSINE TRIPHOSPHATE FROM AQUATIC ENVIRONMENTS,

Geological Survey, NSTL Station, MS. Water Resources Div.
D. W. Stephens, and D. J. Shultz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-216798, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 81-5, 1981. 28 p, 6 Fig, 6 Tab, 31 Ref.

Descriptors: *Adenosine triphosphate, *Chemical analysis, *Pollutant identification, Sampling, Microorganisms, Sediments, Algae, Bacteria, Bioluminescience, *Biomass, Separation techniques, Extraction, Acid extractants.

A variety of adenosine triphosphate (ATP) extraction procedures have been investigated for their applicability to samples from aquatic environments. The cold sulfuric-oxalic acid procedure was best suited to samples consisting of water, periphyton, and sediments. Due to cation and fulvic acid interferences, a spike with a known quantity of ATP was necessary to estimate losses when sediments were extracted. Variable colonization densities for periphyton required that several replicates be extracted to characterize accurately the periphyton community. Extracted samples were stable at room temperature for one to five hours, depending on the ATP concentration, if the pH was below 2. Neutralized samples which were quick frozen and stored at -30C were stable for months. (USGS)
W81-05731

## INTERLABORATORY COMPARISON: ACUTE TESTING SET,

Environmental Research Lab., Duluth, MN.
A. E. Lemke.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-160772, Price codes: A03 in paper copy, A01 in microfiche.
Project Summary EPA-600/S3-81-005, April, 1981. 2 p.

Descriptors: *Bioassay, *Testing procedures, *Fish, *Endosulfan, *Silver nitrate, Pesticides, Daphnia, Fathead minnows, Trout, Statistical analysis, Comparison studies.

A multiple laboratory (6) seet of tests was conducted using a single Test Standard Method. Fathead minnows and rainbow trout were exposed to endosulfan and silver nitrate in static and dynamic tests to determine the 96 hr LC50. Acute static tests were also conducted for 48 hr with Daphnia magna with both chemicals. The extreme values for any one test were one order of magnitude while the extremes of the means were only a factor of 2. If a standard protocol is followed closely and a material is not water quality dependent, a very precise set of data can be expected. Species sensitivity is highly variable and species from widely diverse groupd should be tested. The means of repeated tests (at least two) apparently gives a number of sufficient precision that can be reproduced with confidence. Extreme care should be

exercised in all extrapolations especially between diverse genetic groups. (Brambley-SRC)
W81-05761

**TRADESCANTIA MCN-IN-TETRAD MUTAGEN TEST FOR ON-SITE MONITORING AND FUTHER VALIDATION,**
Western Illinois Univ., Macomb. Dept. of Biological Sciences.
T-H. Ma.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-168700, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S1-81-019, April, 1981. 2 p, 1 Fig.

Descriptors: *Bioassay, *Mutagens, *Air pollution, *Water pollution, *Monitoring, Drinking water, Reservoirs, Gases, Pollutants, Tradescantia micronucleus bioassay, Pollutant identification.

The Tradescantia Micronucleus (Trad-MCN) Bioassay has been used as a mutagenicity screening test for air and water pollutants, and as an air monitoring test at 11 eleven sites. The test relies on the frequency of chromosome damage in the form of micronuclei at the synchronized tetrad stage. Three sites showed higher micronucleus frequencies than their controls. Four gases, nitrogen dioxide, sulfur dioxide, ozone, and hydrogen azide showed positive responses. Of the water-soluble pollutants, ascorbic acid, manganese chloride, sodium bisulfate, saccharin, and zinc chloride gave positive results, niacin and sodium nitrate were negative, and propionic acid and lead acetate were inconclusive. Three known mutagens, benzo(a)pyrene, cyclohexylamine and maleic hydrazide were all positive. Spring Lake (Macomb city reservoir) water was tested and compared with tap water after disinfection treatment. In most cases, tap water gave relatively higher mutagenicity than the lake water. The Trad-MCN bioassay showed high efficiency and versatility and is suitable for preliminary screening of environmental pollutants and in-situ monitoring. (Brambley-SRC)
W81-05762

**THE PRECISION OF THE ASTM BIOCONCENTRATION TEST,**
Wisconsin Univ.-Superior. Center for Lake Superior Environmental Studies.
P. Kosian, A. Lemke, K. Studders, and G. Veith.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-168932, Price codes: A02 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-022, April, 1981, 3 p.

Descriptors: *Biological magnification, *Absorption, *Water pollution effects, *Benzenes, *DDE, Computers, Fish, Chlorinated hydrocarbons, Testing procedures, Pollutant identification.

Bioconcentration is the direct uptake of a chemical into aquatic organisms through the gill or other membranes. The bioconcentration factor (BCF) is the ratio of the chemical residue in the fish tissue and the concentration of the chemical in the water after a steady-state is observed. The ASTM method for measuring the BCF of chemicals was evaluated using 1,2,4-trichlorobenzene (TCB), hexachlorobenzene (HCB), and p, p'-DDE (DDE). Four replicate, 28-day exposures of the chemicals to fathead minnows were used to determine the precision of the test method. Using the 28-day values, the mean BCF for TCB, HCB, and DDE were 1,700 (+ or - 70), 35,000 (+ or - 3,300), and 50,000 (+ or - 4,800), respectively. The results show that steady-state residues are not attained for highly bioaccumulative chemicals in the 28-day exposure, and the calculation of the BCF by dividing the 28-day residues by the mean water concentration is inadequate. To compare different methods of estimating BCF from a given set of uptake and depuration data, the data were also analyzed using a modified BIOFAC computer program and a non-linear curve-fitting program (CANDLES). All three methods give essentially the same values for TCB, which was tested to near steady-state. However, both the BIOFAC and CANDLES programs estimated that the steady-state BCF for HCB and DDE are substantially higher than is estimated from the 28-day value. (Moore-SRF)
W81-05768

**MUTAGENISTIC TESTING OF INDUSTRIAL WASTES FROM REPRESENTATIVE ORGANIC CHEMICAL INDUSTRIES,**
East Central Oklahoma State Univ., Ada.
S. Stinnett, and J. E. Matthews.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-155574, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-007, March, 1981, 3 p.

Descriptors: *Mutagens, *Waste water analysis, *Industrial waste water, Carcinogens, Chemical industry, Economic aspects, Effluent, Water quality.

The general applicability of the Ames test for screening waste water samples was investigated. Application of the Ames test to raw and treated waste waters from representative organic chemicals industries involved the investigation of several problems: the feasibility of using the Ames test to detect mutagens in waste water samples, the relative effectiveness of various waste treatment processes, the mechanics of establishing an Ames testing program, and the economics of using the test in routine environmental screening. Samples collected from 14 industrial sites were analyzed using the Ames procedure. Results were interpreted on the basis of relative increases in revertant colonies on test plates as compared to control spontaneous reversion plates. A positive sample consisted of six replicate test plates with an average count of at least twice the control value. Of 28 samples tested, 6 were interpreted as positive and 22 were interpreted as negative. Because the mutagenic agents are so dilute in waste water, negative results do not necessarily indicate the absence of mutagens. There is also a potential for obtaining false positives using this procedure, so that it is not reasonable to classify a sample as positive or negative on the basis of this test alone. (Moore-SRC)
W81-05775

**INTERRELATIONSHIP OF BACTERIAL COUNTS WITH OTHER FINISHED WATER QUALITY PARAMETERS WITHIN DISTRIBUTION SYSTEMS,**
Salem and Beverly Water Supply Board, Beverly, MA.
For primary bibliographic entry see Field 5F.
W81-05780

**COPPER COMPLEXING CAPACITY OF SEAWATER: A CRITICAL APPRAISAL OF THE DIRECT ASV METHOD,**
Hebrew Univ., Jerusalem (Israel). Dept. of Geology.
B. Lazar, A. Katz, and S. Ben-Yaakov.
Marine Chemistry, Vol 10, No 3, p 221-231, April, 1981. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Copper, *Anodic stripping voltammetry, *Seawater, Pollutant identification, Chelation, Zinc, Mercury, Electrodes, Water analysis.

Direct anodic stripping voltammetry (ASV) is probably applicable to the determination of copper apparent complexing capacity in lake water, but not in normal seawater. The break point in the Cu(2+) titration curve obtained by this method, usually attributed to the formation of strong organo-copper complexes, is used to directly determine the copper complexing capacity of water. This study suggests that the break in the titration curve could be caused by a formation of a Zn-Cu intermetallic compound formed in the mercury amalgam during the deposition stage of the ASV procedure. The ratio between the two slopes of the titration curve may be an indicator for the cause of the break, low ratios suggesting an intermetallic compound origin, and high ratios, apparent complexing capacity. (Cassar-FRC)
W81-05829

**ORGANOCHLORINES - AN OVERVIEW,**
Freshwater Fisheries Lab., Fitlochry (Scotland).
A. V. Holden.
Marine Pollution Bulletin, Vol 12, No 4, p 110-115, April, 1981.

Descriptors: *Organic pesticides, *Chlorides, *Water analysis, DDT, Water pollution sources, Agricultural chemicals, Pesticides, Monitoring, *Pollutant identification.

An overview is presented of the potential water pollution problems posed in the quantification of organochlorines such as DDT. Concentrations of organochlorines in animal tissues are detected using gas liquid chromatography and electron capture techniques. Only a small number of laboratories perform this work, and unless the data are reliable in terms of identification of the contaminants and quantification, incorrect decisions can be made on the extent of pollution or pollution control measures. Mass spectrometry can be linked to gas chromatographs to provide a more reliable means of identifying individual compounds in a sample, but the information must be handled by a data processing system coupled to the MS. Adsorbent columns work well with HCB, HCH, dieldrin, DDT and its metabolites, and PCBs. Toxaphene is an example of a persistent pesticide widely used in North America that is difficult to quantify in environmental samples. Most laboratories routinely report only the well-known organochlorine compounds and do not look for less publicized ones such as toxaphene and mirex. Improved methods are needed for organochlorine analysis, and a comprehensive plan for monitoring these chemicals in the marine environment must be implemented. Coastal monitoring, such as a mussel survey, would be particularly valuable in determining the extent of these persistent, widely used chemicals. (Small-FRC)
W81-05836

**ACCUMULATION OF COPPER, ZINC, CADMIUM, AND LEAD FROM TWO CONTAMINATED SEDIMENTS BY THREE MARINE INVERTEBRATES--A LABORATORY STUDY,**
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
For primary bibliographic entry see Field 5B.
W81-05858

**RELATIONSHIP OF MORTALITY OF AQUATIC BIOTA FROM 96-HOUR SEDIMENT BIOASSAYS AND THE CHANGE IN CHEMICAL COMPOSITION OF THE TEST WATER,**
Aqua Tech Environmental Consultants, Inc., Melmore, OH.
For primary bibliographic entry see Field 5C.
W81-05859

**ACUTE TOXIC RESPONSES OF THE FRESHWATER PLANARIAN, DUGESIA DOROTOCEPHALA, TO CHLORDANE,**
Colorado State Univ., Fort Collins. Dept. of Physiology and Biophysics.
For primary bibliographic entry see Field 5C.
W81-05871

**FACTORS INFLUENCING HOUSEHOLD WATER LEAD: A BRITISH NATIONAL SURVEY,**
Royal Free Hospital School of Medicine, London (England). Dept. of Clinical Epidemiology and Social Medicine.
S. J. Pocock.
Archives of Environmental Health, Vol 35, No 1, p 45-51, January/February, 1980. 2 Fig, 5 Tab, 22 Ref.

Descriptors: *Lead, *Pipes, *Plumbing, Heavy metals, Pollutant identification, Water quality, Water supply, Domestic water, *Great Britain, Blood, Acidic water, Hydrogen ion concentration, *Public health, Water treatment, Water distribution.

A survey of 2,831 households in England, Scotland, and Wales provided data for an assessment of the factors affecting Pb content of household

water. Samples of first-draw water, lakely to have the maximum daily Pb levels, and day-time water water, typical of water used throughout the day, were collected. pH was the most significant factor affecting Pb levels. Water in two-thirds of homes using water with pH less than 6.8 had Pb levels in excess of 0.1 mg per liter, the World Health Organization recommended limit. Water with alkalinity less than 100 mg per liter averaged 0.028 mg per liter Pb. The length of Pb piping was relatively unimportant: levels in water ranged from 0.018 mg Pb per liter for less than 5 meters of Pb pipe to 0.069 for 30 meters and greater. Households with Pb supply pipes only had lower water Pb levels than homes with Pb household pipes only. Pb concentrations in water from homes with 100% Pb piping averaged 0.058 mg per liter; those with less than 50%, 0.025 mg per liter. Post-1944 houses had lower Pb levels in their water supplies than older homes. Number of occupants was inversely related to Pb levels, probably because water stands in the pipes longer in homes of smaller families. The efficiency of remedial measures was evaluated. Factors for which no relationship was found to tap water Pb levels were conductivity, color, noncarbonate hardness, chloride, and nitrate. Chemical treatment of acid waters would reduce blood Pb levels by 20% among residents with Pb plumbing, or 1% nationally and 5% in Scotland, where acid water is common. Removal of all lead pipes in acid water areas, a costly procedure, would reduce blood Pb levels by 30% among the residents affected. In harder water areas, Pb blood levels would drop 15%, for an overall reduction of 5-10%. (Cassar-FRC)
W81-05876

**GLASS CAPILLARY COLUMNS IN THE GAS CHROMATOGRAPHIC AND GAS CHROMATOGRAPHIC-MASS SPECTROMETRIC DETERMINATION OF TRACE LEVELS OF KEPONE IN NATURAL WATERS,**
New Orleans Univ., LA.
I. R. DeLeon, P. C. Remele, S. K. Miles, and J. L. Laseter.
Analytical Letters, Vol 13, No A6, p 503-515, 1980. 1 Fig, 19 Ref.

Descriptors: *Chemical analysis, *Water analysis, *Kepone, Insecticides, *Gas chromatography, Pollutant identification, Spectrometry, Mass spectrometry, Chromatography, Chlordecone, Organic compounds.

The application of high-resolution glass capillary columns to the analysis for kepone (chlordecone) in environmental samples by gas chromatography and gas chromatography-mass spectrometry is described. The use of glass capillary columns makes it possible to rapidly screen and analyze kepone at a detection limit of 2 ng/liter in natural waters. However, even using glass capillary columns, electron capture determinations for kepone are subject to error. The use of isopropanol in solutions containing kepone reduced the variability of the kepone detector response by as much as six times. Samples of waters were taken from several locations in the United States where kepone contamination was alleged to be present. The samples were collected in amber bottles equipped with Teflon-lined caps and shipped in insulated containers. The water was acidified and extracted with dichloromethane. Analysis was carried out by GC using electron capture detection and high resolution glass capillary columns. Of the several solvent systems explored, dichloromethane gave the best recovery, at 85%, with a relative standard deviation of 3.2% at the 50 ng/liter concentration level and an analytical sensitivity of at least 2 ng/liter. (Baker-FRC)
W81-05890

**ANALYSIS OF POLYNUCLEAR AROMATIC HYDROCARBONS IN SEWAGE SLUDGES,**
Imperial Coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. E. McIntyre, R. Perry, and J. N. Lester.
Analytical Letters, Vol 14, No 4, p 291-309, 1981. 6 Tab, 27 Ref.

Descriptors: *Polyaromatic hydrocarbons, *Sludge, *Chemical analysis, Organic compounds, Hydrocarbons, *Pollutant identification, Carcinogens, *Chromatography, Sludge disposal.

A method for determination of polyaromatic hydrocarbons (PAH) in sewage sludges involves solvent extraction with cyclohexane, cleanup of the extract by silica gel thin-layer chromatography, and final separation of the purified PAH by 2-dimensional thin-layer chromatography. Comparison of the sample chromatogram plates under ultraviolet light gives a semiquantitative result. The disperser extraction procedure recovered PAH more efficiently from sewage sludge than did the funnel and Ultra-Turrax homogenizer methods. Recovery was 100% for fluoranthene, benzo(k)fluoranthene and benzo(g,h,i)perylene and 80% for benzo(a)pyrene, benzo(b)fluoranthene and indeno(1,2,3,c-d)pyrene. Twelve United Kingdom sewage sludges were analyzed. PAH concentrations varied considerably, from 60 to 1760 micrograms per liter. Fluoranthene appeared in highest concentrations, 17 to 400 micrograms per liter. Domestic-origin sewage sludge PAH levels were 78 to 108 micrograms per liter, and industrial-origin sludge levels, 273 to 428 micrograms per liter. (Cassar-FRC)
W81-05891

**ROUTINE DETERMINATION OF PARTICULATE SILICA IN WATER,**
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
M. S. Simmons.
Analytical Letters, Vol 13, No A1, p 67-74, 1980. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Water analysis, *Silica, *Chemical analysis, Lakes, Lake Michigan, Particulate matter, Atomic absorption spectrophotometry, Spectrophotometry, Photometry.

The determination of particulate silica in water or biogenic material is described. The decomposition of the sample was satisfactorily achieved through treatment with a mixture of hydrofluoric and nitric acids. After standing at room temperature overnight, the mixture was treated with boric acid, taken up with water, and analyzed for silicon by atomic absorption spectrophotometry using a nitrous oxide-acetylene flame. The reproducibility of the decomposition method was 5%. Recovery after addition of known amounts of pure silicon oxide standards to the lakewater samples was 90 to 95%. Analysis by this method of 900 water samples from the inshores of Lake Michigan showed 0.1 to 2.0 mg/liter SiO2 for total particulate silica. This number of samples was easily processed and analyzed within a week's time. (Baker-FRC)
W81-05906

**MICROANALYSIS OF AQUEOUS SAMPLES FOR PHENOLS AND ORGANIC ACIDS,**
Environmental Research Group, Emeryville, CA.
W. A. Prater, M. S. Simmons, and K. H. Mancy.
Analytical Letters, Vol 13, No A3, p 205-212, 1980. 2 Tab, 16 Ref.

Descriptors: *Phenols, *Chemical analysis, Industrial wastes, Carboxylic acids, Trace analysis, Water quality control, Water pollution control, Resins, *Aqueous solutions.

A method is described for determining carboxylic acids and phenols from aqueous solution. Trace concentrations in the ppb range are detectable. This is accomplished by a concentration step using macroreticular resins with pyridine elution, subsequent derivatization with bis-trimethylsilyl acetamide (BSA), and analysis by gas chromatography. The method gives good recovery for several phenols and acids of environmental importance. In addition to reducing losses during evaporation by induced salt formation, the pyridine serves several purposes in the procedure: rapid elution of acidic materials from the resin can be done with a small volume; distillation of the pyridine-water azeotrope of 57% pyridine and 43% water removes even the last traces of water; and pyridine acts as a catalyst in the formation of the trimethylsilane derivative. The reaction of bis-trimethylsilyl acetamide and each of the acids and phenols was complete within 15 minutes after addition of the reagent. The time for complete reaction was, in most cases, less than two minutes. After running a series of samples containing various amounts of BSA, a composition of one part BSA by volume to three parts solvent (DMF:pyridine, 1:2) was needed to produce stable derivatives rapidly. (Baker-FRC)
W81-05907

**A RADIOCHEMICAL MICROTECHNIQUE FOR THE DETERMINATION OF TRACES OF AMMONIA AND AMMONIUM SALTS,**
Dortmund Univ. (Germany, F. R.). Abt Chemie.
A. Teckentrup, and D. Klockow.
Analytical Letters, Vol 13, No A7, p 611-624, 1980. 2 Fig, 1 Tab, 16 Ref.

Descriptors: *Chemical analysis, *Ammonia, Water, *Radiochemical analysis, Radioactivity techniques, Rain.

A radiochemical procedure is described for the determination of trace amounts of ammonia and ammonium ions in aqueous solutions. Ammonia is precipitated in a buffered medium by Hg(II)-203 as Hg2NCl. If the same amount of the radioreagent is always employed, a negative linear correlation is obtained between the amount of ammonia to be determined and the activity of the supernatant liquid. If a microdiffusion preconcentration step is combined with the radiochemical procedure, the working range of the new method can be extended to ammonia concentrations as low as 0.04 microg N/ml. The method is applied to the analysis of rain water and air filter samples and compared with the indophenol blue technique. The radiochemical microtechnique can be applied to the analysis of environmental samples as an alternative to photometric and electrochemical procedures. Several working ranges can be made accessible by varying radioreagent and buffer concentrations. The combination of a simple microdiffusion step with the radioreagent procedure enhances sensitivity and selectivity of the method. (Baker-FRC)
W81-05908

**MODIFICATION OF TRACE ELEMENT CONCENTRATIONS IN NATURAL WATERS BY VARIOUS FIELD SAMPLING TECHNIQUES,**
Los Alamos Scientific Lab., NM.
J. W. Owens, E. S. Gladney, and W. D. Purtymun.
Analytical Letters, Vol 13, No A4, p 253-260, 1980. 2 Tab, 33 Ref.

Descriptors: *Water analysis, *Sampling, *Sample preservation, Sample preparation, Water sampling, Trace levels, *Trace elements.

A study was undertaken to determine the effects of sample collection and preservation methods on trace element determinations. Four sampling and preservation techniques were used on 23 surface and ground water stations to determine the method which would best approximate the natural trace element concentration. The samples collected and preserved were analyzed as precisely as possible to ascertain any difference in the collection methods. In the first method the samples were collected and immediately filtered in the field, using stainless steel pressure filtering apparatus. They were filtered into linear polyethylene bottles, acidified and capped. In the second method, samples were taken, acidified, and brought back to the laboratory, at which time they were vacuum filtered and transferred into linear polyethylene bottles. In the third method, samples were collected in the field and returned to the laboratory, where they were vacuum filtered and transferred into linear polyethylene bottles. No acid was used for preservation. In the fourth method, samples were collected in the field and returned to the laboratory, where they were vacuum filtered and transferred into linear polyethylene bottles and then acidified with nitric acid. Eighteen dissolved inorganic species were measured for each of 23 sampling stations. Uranium was determined by thermal neutron induced delayed neutron emission; vanadium, aluminum and manganese by instrumental thermal neutron activation analysis; and the rest were analyzed by flameless atomic absorption spectrophotometry.

It was concluded that field treatment of the sample is not a prerequisite for accurate results except in the case of mercury analyses. Samples should be acidified within a few hours after collection. (Baker-FRC)
W81-05909

**RELIABILITY OF WATER ANALYSIS KITS,**
Auburn Univ., AL. Agricultural Experimental Station.
C. E. Boyd.
Transactions of the American Society, Vol 109, No 2, p 239-243. March, 1980. 5 Tab, 5 Ref.

Descriptors: *Water analysis, *Measuring instruments, Chemical analysis, Data acquisition, Water quality, Water quality control, Water sampling.

Samples were obtained from experimental ponds on the Fisheries Research Unit, Auburn University, and from private ponds in east central Alabama. The samples represented a wide range of water quality. The following water quality analysis kits were used, and the results obtained were compared: Bausch and Lomb SpectroKits, Ecologic test kits, and CHEMetrics test kits. Factors tested included calcium hardness, carbon dioxide, chloride, nitrate, nitrite, orthophosphate, pH, sulfate, total alkalinity, total ammonia nitrogen, total chlorine, total hardness, and turbidity. The results of analyses with water analysis kits were highly correlated with concentrations of standard solutions used. In replicate analysis of pond water, the kits gave results that often differed from (and usually were less precise than) standard methods. When large series of water samples were analyzed, the values obtained from the kits and standard methods were highly correlated. Even so, regression intercepts seldom were 0 and slopes seldom were 1.0. It was concluded that water analysis kits as tested here were not suitable when high accuracy and precision are needed. However, kits are sufficiently reliable in many operations not requiring such precision. (Baker-FRC)
W81-05913

**HYDRAZINE: ACUTE TOXICITY TO BLUEGILLS AND SUBLETHAL EFFECTS ON DORSAL LIGHT RESPONSE AND AGRESSION,**
Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
J. W. Fisher, C. B. Harrah, and W. O. Berry.
Transactions of the American Fisheries Society, Vol 109, No 3, p 304-309, May, 1980. 3 Tab, 38 Ref.

Descriptors: *Organic wastes, *Fish, *Toxicity, Fish behavior, *Bluegills, *Hydrazine, Agricultural chemicals.

Hydrazine is widely used as an industrial and military chemical, manufactured at present in amounts of 9 million kg per year. It has a high aquatic hazard potential, and thus sensitive sublethal behavioral indicators of hydrazine contamination are needed. To test effects of hydrazine on the dorsal light response (tilting of the dorsal surface toward a strong directional light source) small bluegills were acclimated to laboratory aquaria for two weeks. The static 96-hr median lethal concentration of hydrazine for bluegills was calculated to be 1.08 mg/liter, with 95% fiducial limits of 0.54-1.81 mg/liter. Under continuous-flow conditions, the no-lethal-effect concentration was 0.43 mg/liter. Hydrazine did not affect the tilt of the bluegills without prey present, but tilt was significantly decreased in the 0.43 mg/liter concentration when prey was present. Both static and continuous-flow experiments indicated that hydrazine caused a decrease in the bluegill's dorsal light response in the presence of prey. Attacks of bluegills on the prey were increased by hydrazine under static and continuous-flow conditions, apparently in a dose-related fashion. This study supports the concept that toxicant-caused stresses on organisms can be quantified by methods other than acute mortality. These behavioral measurements offer some promise as monitors of subtle, sublethal effects of hydrazine and possibly other aquatic pollutants on fish. (Baker-FRC)
W81-05928

**THE DETERMINATION OF TRACE AMOUNTS OF SELENIUM BY HYDRIDE GENERATION-NONDISPERSIVE FLAME ATOMIC FLUORESCENCE SPECTROMETRY,**
Osaka Prefecture Univ. (Japan). Dept. of Applied Chemistry.
T. Nakahara, S. Kobayashi, T. Wakisaka, and S. Musha.
Applied Spectroscopy, Vol 34, No 2, p 194-200, March/April, 1980. 3 Fig, 7 Tab, 50 Ref.

Descriptors: *Chemical analysis, *Wastewater, *Selenium, Spectrometry, Flame atomic fluorescence spectrometry, Pollutant identification.

Trace selenium is detected by generation of its gaseous hydride using either metallic zinc or sodium borohydride as a reductant. This is followed by the introduction of the hydride into premixed argon-hydrogen flame, where all atomic fluorescence lines of selenium are simultaneously detected by use of a nondispersive system. The comparison of the zinc and sodium borohydride reduction methods is discussed in terms of detection limit, precision, and interference. Using the zinc and borohydride methods, respectively, the best detection limits for selenium were 0.3 ng and 0.4 ng/liter. Most mineral acids in the range of 2.0 M do not interfere. However, nitric acid gives a depressive interference. This interference is much more severe in the zinc than in the borohydride reduction methods. Several elements caused a depressive interference, including other hydride-forming elements in 1000-fold ratio to selenium. An enhancing interference was noted from tellurium only in the zinc reduction method. The described method has been successfully applied to the determination of selenium in wastewaters and foods. (Baker-FRC)
W81-05942

**INDIRECT ANALYSES OF SULFATE IN BRINES BY ATOMIC ABSORPTION,**
Pontificia Univ. Catolica do Rio de Janeiro (Brazil). Dept. de Quimica.
M. I. Couto, and A. J. Curtius.
Applied Spectroscopy, Vol 34, No 2, p 228-229, March/April, 1980. 1 Tab, 15 Ref.

Descriptors: *Sulfates, *Chemical analysis, Brines, *Atomic absorption spectroscopy, Pollutant identification, Spectroscopy.

Some indirect methods of sulfate analysis use barium chloride to precipitate sulfate as $BaSO_4$. The excess barium remaining in solution is measured by atomic absorption or flame emission, and the sulfate content is calculated. An adaptation of this method has now been applied to the analyses of samples of oilfield water and sea water. Two modifications are proposed to the indirect method by atomic absorption for brines, one applying the standard addition method for the Ba measurements using a Y-shaped capillary aspirator, and the other using prior separation with alumina of the sulfate from the other ions. A Varian-Techtron AA-5 spectrophotometer was used in all measurements. The procedure calls for adjusting the pH of the sample to the 7.2 and 8.0 range with diluted HCl. Barium and potassium are added. After shaking, the sample flask is allowed to stand for 20 hr. The supernatant liquid is diluted 10 fold and the absorbances are read. In modification I the supernatant liquid is aspirated through one arm of a Y-shaped double capillary system. A series of Ba standards is aspirated through the other arm, while the absorbances are read. The results of analyses by four procedures are compared, and those obtained by the two modifications agree favorably with those obtained with the gravimetric method. (Baker-FRC)
W81-05943

**A MODIFIED ONE-METRE FRIEDINGER SAMPLER: A DESCRIPTION AND SOME SELECTED RESULTS,**
Freshwater Biological Association, Windermere (England).
A. E. Irish.
Freshwater Biology, Vol 10, No 2, p 135-139, April, 1980. 2 Fig, 2 Tab, 12 ref.

Descriptors: *Water analysis, *Measuring instruments, *Phytoplankton, Lakes, Sampling, Sampler, Vertical distribution.

This paper describes an extended one meter long water sampler which is used for sampling sequentially from the surface waters downwards, allowing the estimation of biological and chemical variables in a 'complete' column and their vertical distribution. Such a column is presented for the dinoflagellate ceratium hirundinella. The sampler consists basically of a one meter length of a hollow transparent perspex cylinder of internal diameter 7.6 cm and external diameter 8.9 cm. The uppermost hinged flap has a small vent, and the lowermost hinged flap has a tap for sample withdrawal. These flaps are attached to aluminum rims which fit onto the ends of the tube, both rims being held in position on the tube by four steel rods which connect with each rim. Closure of the flaps is by way of a quick-release mechanism activated by a weighted messenger. The results indicated that a contagious distribution of Ceratium occurred not only in the 0-5 meter vertical water column but also in each one meter depth section. The main disadvantage of the one meter sampler is the difficulty in obtaining a representative homogenous sample from he sampler when using its tap. The contents of the one meter sampler tend to be heterogenous, especially during nonisothermal conditions. Thus it is stressed that it is essential to empty the entire contents of the sampler into a container for thorough mixing before taking subsamples to estimate the number of organisms in each sampling unit. (Baker-FRC)
W81-05969

**ULTRA-TRACE ANALYSIS OF SOLUBLE ZINC, CADMIUM, COPPER AND LEAD IN WINDERMERE LAKE WATER USING ANODIC STRIPPING VOLTAMMETRY AND ATOMIC ABSORPTION SPECTROSCOPY,**
Freshwater Biological Association, Windermere (England).
For primary bibliographic entry see Field 2H.
W81-05971

**MONITORING OF DDT, PCBS, AND OTHER ORGANOCHLORINE COMPOUNDS IN MARINE ORGANISMS FROM THE NORTH AEGEAN SEA,**
Thessaloniki Univ., Salonika (Greece). Dept. of Food Hygiene.
S. D. Kilikidis, J. E. Psomas, A. P. Kamarianos, and A. G. Panetsos.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 4, p 496-501, 1981. 3 Fig, 4 Tab, 12 Ref.

Descriptors: *Chlorinated hydrocarbons, *Marine animals, *Baseline studies, *Coastal waters, Water pollution, Pesticides, Insecticides, Hexachlorobenzene, Farm wastes, Industrial wastes, DDT, Polychlorinated biphenyls, Aldrin, Deltas, Biological magnification, DDD, DDE.

The levels of organochlorine compounds present as residues in various biota from the coastal waters of the North Aegean Sea were monitored to establish background levels of these pollutants. Sampling stations were located along the deltas of six main rivers of three important industrial and agricultural areas. Only DDT, DDE, and DDD were present in sufficient amounts for reliable determinations. All fish samples had aldrin levels below the detection limit of 0.01 nanograms. All samples analyzed contained PCB and DDE. High levels of PCB in Mullus babatus from the Strymonikos gulf were attributed to local sources of pollution plus the inflow effect of the Strymon river. DDT values averaged 14 ppb wet weight for Mytilus galloprovincialis, while PCB levels were 340 ppb. Both of these pollutants varied annually. More contamination by organochlorines was found in marine organisms of higher trophic levels than of lower levels. (Geiger-FRC)
W81-06026

**A NOTE ON THE POLAROGRAPHIC BEHAVIOR OF THE CU(II) ION SELECTIVE ELECTRODE IN SEAWATER,**

Naval Ocean Systems Center, San Diego, CA.
A. Zirino, and P. F. Seligman.
Marine Chemistry, Vol 10, No 3, p 249-255, April, 1981. 3 Fig, 14 Ref.

Descriptors: *Copper, *Ion-selective electrodes, *Polarographic analysis, *Seawater, Water analysis, Pollutant identification, Metals, Electrodes.

The behavior of the Cu(2+) ion selective electrode (ISE) in seawater resembles that of a polarographic electron donor rather than a standard ISE. This agrees with the mechanism proposed by Westall et al. (1979), who suggested that the electron donor is an impurity of metallic copper in the Ag2S-CuS crystal matrix. Thus the reactivity of the ISE may depend on exposure of fresh Cu at the surface. Oxygen added to the continuously flowing seawater caused a shift toward the positive. Replacing the oxygen with nitrogen restored the potential. Because the Cu(2+) ISE is relatively nonspecific, and the generated potential is not an equilibrium potential, it cannot be used to measure the Cu(2) activity in solution in the thermodynamic sense. However, it can be used to detect the presence of Cu(2+) in seawater. (Cassar-FRC)
W81-06034

## 5B. Sources Of Pollution

**PREIMPOUNDMENT WATER QUALITY IN THE TIOGA RIVER BASIN, PENNSYLVANIA AND NEW YORK,**
Geological Survey, Harrisburg, PA. Water Resources Div.
J. R. Ward.
Available from the National Technical Information Service, Springfield, VA 22161 as AD-A101909, Price codes: A07 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-1, March, 1981. 142 p, 12 Fig, 24 Tab, 17 Ref.

Descriptors: *Acid mine drainage, *Path of pollutants, *Water quality, *Preimpoundment, *Reservoirs, Streams, Data collections, Heavy metals, alkalinity, Nutrients, Phytoplankton, Chemical analysis, *New York, *Pennsylvania, tioga River basin, Suspended sediments.

Acid-mine drainage entering the Tioga River above Blossburg, Pa., degrades water quality for most of its length by increasing levels of sulfate, trace elements and specific conductance, and decreasing alkalinity and pH. Mill creek near Tioga and Crooked Creek are alkaline tributaries that help to neutralize acid-mine drainage in the Tioga River. The Cowanesque River is also alkaline, but slightly affected by industrial effluents near Westfield, and has high chloride levels. Nutrient levels in the basin are generally low, but high enough to support biological activity. Diel measurements indicate that mine drainage has repressed biological activity in the Tioga River. Most of the phytoplankton samples have low diversity indices. Concentrations of many of the water-quality parameter were related to discharge using regression techniques. annual suspended-sediment yields averaged 575 tons per square mile above the downstream limit of the study. Mill Creek near Tioga and the Cowanesque River upstream from Nelson were the lowest contributors of suspended sediment. (USGS)
W81-05711

**DISTRIBUTION OF AQUIFERS, LIQUID-WASTE IMPOUNDMENTS, AND MUNICIPAL WATER-SUPPLY SOURCES, MASSACHUSETTS,**
Geological Survey, Boston, MA. Water Resources Div.
D. F. Delaney, and A. Maevsky.
Geological Survey Open-File Report 80-431 (WRI), 1980. 1 Sheet, 1 Fig, 1 Tab, 3 Ref.

Descriptors: *Aquifers, *Liquid wastes, *Water supply, *Water pollution sources, *Massachusetts, Groundwater, Aquifer characteristics, Water yield, Wells, *Waste-water disposal, Infiltration, water quality, Maps.

Impoundments of liquid waste are potential sources of ground-water contamination in Massachusetts. The map report, at a scale of 1 inch equals 4 miles, shows the idstribution of aquifers and the locations of municipal water-supply sources and known liquid-waste impoundments. Ground water, an important source of municipal water supply, is produced from shallow sand and gravel aquifers that are generally unconfined, less than 200 feet thick, and yield less than 2,000 gallons per minute to individual wells. These aquifers commonly occupy lowlands and stream valleys and are most extensive in eastern Massachusetts. Surface impoundments of liquid waste are commonly located over these aquifers. These impoundments may leak and allow waste to infiltrate underlying aquifers and alter their water quality. (USGS)
W81-05712

**RECONNAISSANCE STUDY OF LEACHATE QUALITY FROM RAW MINED OIL SHALE-LABORATORY COLUMNS,**
Industrial Environmental Research Lab., Cincinnati, OH.
E. Bates, R. Wolf, and D. McWhorter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-129017, Price codes: A04 in paper copy, A01 in microfiche. Project Summary EPA-600/S7-80-181, March, 1981. 4 p, 1 Fig, 2 Tab.

Descriptors: *Oil shale, *Leachates, *Water pollution sources, *Trace elements, Heavy metals, Effluents, Mining, Soil chemistry, Aluminum, Boron, Fluorine, Zinc, Lead, Molybdenum.

Potential water quality problems associated with leachate from surface storage of raw shale were studied in the laboratory. Eight different materials were subjected to leaching. Four of the materials were raw mined shales obtained at different locations in the Colorado oil shale region. The other four materials were samples of shales and soils that had been exposed to natural leaching processes. The previously exposed materials provide a baseline that assisted in placing the results for the mined shales in perspective. Results indicate that leachates from mined shales will contain dissolved solids at levels substantially greater than the background levels as indicated by the soils and previously exposed shales. The trace elements Al, B, F, Zn, Pb and possible Mo occur in the leachates from some of the mined shales in quantities significantly greater than in the leachates from the background materials. All other trace elements studied were present in the effluents from the mined shales in about the same concentration as observed in the leachates from the soils and previously exposed shales. (Moore-SRC)
W81-05758

**HELMINTH AND HEAVY METALS TRANSMISSION FROM ANAEROBICALLY DIGESTED SEWAGE SLUDGE,**
Illinois Univ. at Urbana-Champaign.
For primary bibliographic entry see Field 5E.
W81-05760

**EPIDEMIOLOGICAL STUDY OF KLEBSIELLA PNEUMONIAE AMONG PULP AND PAPER MILL WORKERS,**
Wisconsin Univ.-Madison.
M. S. Kanarek, and N. R. Caplenas.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-172298, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S1-81-023, April, 1981. 2 p.

Descriptors: *Pulp and paper industry, *Public health, *Klebsiella, *Infection, *Industrial waste water, *Coliforms, Water reuse, Process water, Sanitary waste water, Epidemiology, Effluents, Water analysis.

In a one-year study fecal coliform and Klebsiella bacteria densities were measured in several of Wisconsin's pulp and paper mill processing wash waters, treated waters, and waters receiving pulp and paper mill effluent discharge. The isolation of fecal coliform bacteria ranged from as low as a minimum detectable level of less than 10 organisms/100 ml mater sample to as high as an estimated 5,000,000 organisms/100 ml water sample. Water data were obtained from an effluent survey of twnety plants and a within-plant survey of three mills. These findings support previous investigations concerning the selective growth of coliform bacteria in pulp and paper mills utilizing processed water recycle loops. Biochemical testing revealed that over 50% (range from 4 to 97%) of the fecal coliform bacteria associated with pulp and paper mill processing were identified as bacteria of the genus Klebsiella, of which K. pneumoniae was found to be the most prevalent species. Sampling of paper mill workers resulted in Klebsiella isolation from the upper respiratory tract. Klebsiella biotyping revealed that the Klebsiella isolation from a pulp mill worker matched the Klebsiella biotype found in the plant's processing waters. An additional relationship was observed between Klebsiella biotypes isolated from plant sanitary sewers and the mill's processing waters. There is a strong suggestion that upper respiratory tract colonization, with potential health hazards, can occur in pulp and paper mill workers occupationally exposed to Klebsiella bacteria. Recycling or reuse of water within the pulp and paper industry has been shown to enhance proliferation of K. pneumoniae densities. Until further research to assess the health risks of populations exposed to water contaminated with Klebsiella is carried out, the U.S. ENvironmental Protection Agency should not encourage recycling within the pulp and paper industries as a means of reducing waste discharges. (Brambley-SRC)
W81-05763

**ENVIRONMENTAL CHARACTERIZATION OF GEOKINETICS' IN SITU OIL SHALE RETORTING TECHNOLOGY,**
Monsanto Research Corp., Dayton, OH.
G. M. Rinaldi, J. L. Delaney, and W. H. Hedley.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-163727, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S7-81-021, April, 1981. 5 p, 2 Fig, 3 Tab.

Descriptors: *Oil shale, *Industrial waste water, *Effluents, Air pollution, Heavy metals, Trace metals, Benzenes, Phenols, Sulfur compounds, Nitrogen compounds, Organic compounds, Water pollution control.

In situ retorting is the oil recovery process in which underground shale deposits are heated in place after the permeability of the rock has been increased by fracturing. Effluents and emissions were sampled and analyzed from Geokinetics, Inc. Retort No. 17, a pilot-scale unit producing 30 barrels of crude shale oil per day, located at the Kamp Kerogen site in Uintah County, Utah. The potential pollution sources tested were the retort off-gases, the exhaust from thermal incineration of demister outlet gases, fugitive gas seepage, retort water after oil separation, and evaporation pond water. The retort water sample contained nitrogen compounds, sulfur compounds, soluble solids, and organic compounds. It also contained certain organic priority pollutants (acrylonitrile, benzene, phenol, toluene) and trace elements (arsenic, boron, iron, strontium) in amounts on the order of one part per million. The presence of these potentially toxic materials makes treatment of oil shale retorting waste waters for discharge or process recycle, already difficult because of the number and amount of conventional pollutants present, a formidable challenge. Additional measurement studies and technical and economic evaluations of treatment alternatives are necessary to prevent potential adverse impacts by integrating pollution control with oil shale development. (Moore-SRC)
W81-05776

**PHOSPHORUS RETENTION MODELS FOR TENNESSEE VALLEY AUTHORITY RESERVOIRS,**
Tennessee Valley Authority, Chattanooga. Div. of Water Resources.

For primary bibliographic entry see Field 2H.
W81-05807

**CONTAMINANT TRANSPORT IN FRACTURED POROUS MEDIA: ANALYTICAL SOLUTION FOR A SINGLE FRACTURE,**
Princeton Univ., NJ.
For primary bibliographic entry see Field 2F.
W81-05813

**EFFECTS OF FLOODS ON NUTRIENT AND METAL CONCENTRATIONS IN A COASTAL PLAIN STREAM,**
Oak Ridge National Lab., TN. Environmental Sciences Div.
P. J. Mulholland, L. A. Yarbro, R. P. Sniffen, and E. J. Kuenzler.
Water Resources Research, Vol 17, No 3, p 758-764, June, 1981. 4 Fig, 3 Tab, 40 Ref.

Descriptors: *Metals, *Nutrients, *Floodwater, *Path of pollutants, *Coastal streams, Streamflow, Particulate matter, Creeping Swamp, *North Carolina, Dissolved solids, Organic matter.

Water quality in Creeping Swamp, a third-order coastal plain stream in North Carolina, was monitored during two 1976 floods, January and June. There were two sampling stations: CP-20 upstream, draining the least disturbed portion of the watershed, and CP-10 downstream, which received effluents from a hog farm. Concentrations of most of the filterable substances remained relatively constant during nonflood periods. At CP-20 flood waters contained lower levels of Cl and higher levels of nitrate and dissolved organic carbons. At C-10 concentrations of filterable N, P, K, and Fe increased markedly during floods. This indicates that increases in concentrations of filterable substances during floods may be better indications of watershed disturbance than ambient concentrations. Levels of particulate forms of P, Fe, Si, and metals increased during the rise of the hydrograph, reached a maximum prior to peak streamflow, and decreased thereafter. (Cassar-FRC)
W81-05814

**MEASUREMENT OF DISTRIBUTION COEFFICIENTS USING A RADIAL INJECTION DUAL-TRACER TEST,**
National Hydrology Research Inst., Ottawa (Ontario).
J. F. Pickens, R. E. Jackson, and K. J. Inch.
Water Resources Research, Vol 17, No 3, p 529-544, June, 1981. 10 Fig, 9 Tab, 47 Ref.

Descriptors: *Solute transport, *Radioactive waste disposal, *Distribution coefficient, *Path of pollutants, Iodine radioisotopes, Strontium radioisotopes, Tracers, Injection wells, Adsorption, Sand aquifers, Aquifers, Plumes, Particle size, Groundwater pollution.

The adsorptive and dispersive properties of a sandy aquifer were evaluated using a radial injection dual-tracer test with I131 as the nonreactive tracer and Sr85 as the reactive tracer. Groundwater monitoring points were located at various levels (2 to 8 meters) and radial distances (0.36, 0.66, and 2.06 meters) from the injection well. In the breakthrough curve analysis, physical and chemical nonequilibrium adsorption effects were incorporated in the dispersion mechanism of the solute transport equation. The effective dispersivity values for Sr85 (range 0.7-3.3 cm, mean 1.9 cm) were 2-5 times greater than those for I131 (range 0.4-1.5 cm, mean 0.8). Distribution coefficient values obtained from analysis of the breakthrough curves at depths of 2.30, 2.66, and 3.05 meters and radial distances of 0.36 and 0.66 meters produced values of 2.6 to 4.5 ml per g. These compare well with values obtained by other methods: 4.3-11.7 ml per g, separation of fluids from solids in sediment cores; 2.8-10.8 ml per g, batch experiments on core sediments; 10 ml per g, analysis of a 25-year old radioactive waste plume located within 50 meters of the injection well. Sr85 radioactivity showed preferential adsorption to the coarset fraction (medium sand), the finest fraction (coarse silt), and the micaceous minerals (biotite and vermiculite). Further evidence for the nonequilibrium nature of the adsorption-desorption phenomena was seen in the relatively slow desorption of Sr85, shown by extreme tailing of the return breakthrough curve and analysis of the radioactivity remaining on sediment cores. (Cassar-FRC)
W81-05815

**LABORATORY MEASUREMENTS OF THE STRONTIUM DISTRIBUTION COEFFICIENT KDSR FOR SEDIMENTS FROM A SHALLOW SAND AQUIFER,**
Queen's Univ., Kingston (Ontario). Dept. of Geological Sciences.
R. J. Patterson, and T. Spoel.
Water Resources Research, Vol 17, No 3, p 513-520, June, 1981. 3 Fig, 5 Tab, 28 Ref.

Descriptors: *Strontium, *Distribution coefficients, *Adsorption, Path of pollutants, Radioactive waste disposal, Groundwater movement, Sediments, Sand aquifers, Aquifer characteristics, Chalk River, Particle size, Vermiculite, Calcium.

Strontium distribution coefficients for sediments were measured by a modified and improved laboratory batch method. The average measured distribution coefficient was 10 ml per g for whole aquifer sediments from the shallow aquifer at Chalk River, Ontario. Comparison values are 7 ml per g determined by the retardation equation and 10 ml per g based on analytical results for aquifer sediments and coexisting groundwaters from a portion of the flow system that is contaminated with Sr90. Values for distribution coefficients (in ml per g) measured for mineral segregates were: quartz, 0.4; muscovite, 2.6; biotite, 3.7; feldspar, 4.7; and biotite altered to vermiculite, 37.0. Vermiculite was the most effective adsorbent phase. These results suggest that the distribution of mineral with respect to grain size strongly influences the distribution coefficient of the whole sediment. Relationships between the distribution coefficient and exchangeable calcium on the sediments and competing cation concentration in the test solutions indicate that electrostatic forces are in primary control of Sr adsorption. (Cassar-FRC)
W81-05819

**DETERMINATION OF RAINFALL DURATION STATISTICS FOR RAIN-OUT MODELS FROM DAILY RECORDS,**
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2B.
W81-05820

**UNBURNED COAL AS A SOURCE OF HYDROCARBONS IN SURFACE SEDIMENTS,**
Woods Hole Oceanographic Institution, MA.
B. W. Tripp, J. W. Farrington, and J. M. Teal.
Marine Pollution Bulltin, Vol 12, No 4, p 122-126, April, 1981. 3 Fig, 3 Tab, 14 Ref.

Descriptors: *Coal, *Hydrocarbons, *Marine sediments, Aromatic hydrocarbons, Water pollution sources, Water pollution effects.

Hydrocarbons extracted from unburned bituminous coal could constitute a significant source of environmental hydrocarbon levels in some coastal areas. Pulverized coal samples were Soxhlet extracted with 3:1 toluene-methanol, and the extract was chromatographed on silica gel to separate the alkanes from the aromatic hydrocarbons. Alkane and aromatic fractions were analyzed by high resolution gas chromatography. Identities of compounds were confirmed by glass capillary gas chromatography-mass spectrometry. Using estimates of coal particles in coastal sediments and an average weight of extractable aromatic hydrocarbons, it was calculated that as much as 40 micrograms/g of the aromatic hydrocarbons found in coastal sediments could be derived from unburned coal. Since the calculation is based on several averages it can not be used to characterize a spcific area, but it is large enough to be of interest to a scientist trying to reconstruct current and historic inputs of hydrocarbons to a coastal environment. (Small-FRC)
W81-05837

**THE IMPACT OF A HIGH LEVEL NUCLEAR WASTE REPOSITORY ON THE REGIONAL GROUND WATER FLOW,**
Analytic and Computational Research, Inc., Los Angeles, CA.
A. Runchal, and T. Maini.
International Journal of Rock Mechanics and Mining Sciences and Geomechanics Abstracts, Vol 17, No 5, p 253-264, October, 1980. 12 Fig, 3 Tab, 20 Ref.

Descriptors: *Groundwater pollution, *Radioactive wastes, *Groundwater hydrology, Geohydrologic units, Underground waste disposal, Waste disposal, Thermodynamics, Temperature effects, Hydrothermal studies, Regional analysis, Radioactive waste disposal, Rock mechanics, Rock properties, Geologic formations.

Deep underground burial of high level nuclear wastes in geologic formations may provide a technologically feasible and attractive alternative for disposal of these wastes. However, many issues relating to the long-term impact of this disposal option on the biosphere are little researched and understood. This paper explores the general impact of a high level waste repository on the regional groundwater flow patterns, emphasizing the long term thermally induced regional groundwater flow. A mathematical model was developed for use in assessing the long-term regional groundwater flow patterns resulting from the placing of high level wastes in a respository. The study concluded that information on hydrogeologic and rock properties which influence the effect of high level wastes on the biosphere is not currently available at the required level of detail. Estimates of the transit times of radionuclides to the biosphere can be made using the equivalent porous medium approch if the equivalence is carried out carefully. It is likely that thermal instability may occur under some conditions, leading to the formation of convection cells in the immediate vicinity of the repository. Under considerable thermal loading, the general direction of the flow through the repository might change from a largely horizontal to a largely vertical pattern, significantly reducing the time required for the radionuclides to reach the near-surface aquifers and the biosphere. Parametic simulations indicated that the flow through the repository, for the conditions investigated, was largely controlled by the thermal loading. The need for further field investigations and theoretical studies is stressed. (Carroll-FRC)
W81-05841

**SHORT-TERM FLUCTUATIONS IN HEAVY METAL CONCENTRATIONS IN ANTARCTIC SNOW,**
British Antarctic Survey, Cambridge (England); and Natural Environment Research Council, London (England).
M. P. Landy, and D. A. Peel.
Nature, Vol 291, No 5811, P 144-146, May, 1981. 2 Fig, 2 Tab, 15 Ref.

Descriptors: *Snow, *Heavy metals, *Antarctic, *Fluctuations, Fate of pollutants, Polar regions, Air pollution effects, Volcanoes, ice cover, Cadmium, Lead, Zinc, Meteorological data collection.

Previous studies have shown that variations in heavy metals in polar ice cores may be the result of global airborne pollutants. Variabilities of polar ice metals in Greenland and Antarctica were much greater than could be accounted for by fluctuations in the annually smoothed emissions of anthropogenic sources and most natural causes. The eruption of volcanoes may account for some of the patterns observed. A remote plateau region of the Antarctic Peninsula showed variations similar in magnitude to those reported for a longer time series. The similarities were consistent with seasonal changes and single snowfall events, suggesting controlby meteorological processes. It was hypothesized that changes in large-scale transpot processes and depositional patterns for long time periods may play an

important part in generating the heavy metal concentration profiles found in deeper ice cores. (Geiger-FRC)
W81-05842

**RECENT GLCIER VARIATIONS AND VOLVANIC ERUPTIONS,**
Washington Univ., Seattle. Quaternary Research Center.
S. C. Porter.
Nature, Vol 291, No 5811, p 139-142, May, 1981. 2 Fig, 72 Ref.

Descriptors: *Claciers, *Volcanoes, *Air pollution effects, *Climatology, Aerosols, Paleoclimatology, Climatic data, Glacial drift, Glaciohydrology, Glaciology, Polar regions, Temperature.

Short term variations in global climate have been attributed to the injection of volcanic dust and gases into the atmosphere during major eruptions. It was estimated that global cooling of about 1 K during priods of intense volcanic activity could lead to a snowline depression large enough to cause glacier advances similar to those of the last several centuries. This hypothesis would be supported if evidence were found of a close relatioship between global volcanicity and the pattern of recent glacier variations. Over the past century, glacier activity of the Nothern Hemisphere exhibited a lack of synchrony with that of the Southern Hemisphere. However, in each hemisphere, glacier variation sequences correspond with acidity records of polar ice cores and the frequency of volcanic eruptions in successive latitude belts. These patterns point to glacier fluctuations in response to the buildup of volcanic aerosols from large eruptions. It was suggested that explosive volanism may play a major role in regulating long term climate patterns. (Geiger-FRC)
W81-05844

**ACCUMULATION OF COPPER, ZINC, CADMIUM, AND LEAD FROM TWO CONTAMINATED SEDIMENTS BY THREE MARINE INVERTEBRATES--A LABORATORY STUDY,**
Department of Fisheries and Oceans, St. Andrews (New Brunswick).
S. Ray, D. W. McLeese, and M. R. Peterson.
Bulltin of Environmental Contamination and Toxicology, Vol 26, No 3, p 315-322, March, 1981. 3 Fig, 2 Tab, 19 ref.

Descriptors: *Heavy metals, *Bioindicators, *Accumulation, *Invertebrates, Marine animals, Cadmium, Lead, Copper. Zinc, Metals, Fate of pollutants, *Sediments, Clams, Shrimp, Polychaetes, Absorption, Bioaccumulation.

Three marine invertebrates, Nerels virens, Macoma balthica, and Crangon septemspinosa, were exposed to two natural, highly contaminated sediments, and the uptake of Cu, Zn, Cd, and Pb was determined. Sediment A was coarser and had lower metal concentrations, except for Cu, than Sediment B. The animals accumulated more Pb, Zn, and Cd from Sediment B and more Cu from Sedment A. The bioavailability of the metals was generally related to the EDTA extraction values. Bioavailability was controlled by factors other than the total extractable metal contents of the sediments, for example, interspecies differences and feeding habits. In most cases, initial uptake was rapid and either followed by a slow decline to the initial level or altered by attainment of new steady state levels. M. balthica appeared useful for short-term testing for Cu, Zn, Cd, and Pb, and N. virens for Cd and Pb. (Cassar-FRC)
W81-05858

**UPTAKE OF PCBS FROM SEDIMENT BY NEREIS VIRENS AND CRANGON SEPTEMSPINOSA,**
Fisheries and Oceans Canada, St. Andrews (New Brunswick).
D. W. McLeese, C. D. Metcalfe, and D. S. Pezzack.
Archives of Environmental Contamination and Toxicology, Vol 9, No 5, p 507-518, September, 1980. 8 Fig, 2 Tab, 17 Ref.

Descriptors: *Polychlorinated biphenyls, *Accumulation, *Aquatic aimals, Polychaetes, Shrimp, *Sediments, Aroclors, DDT, Dieldrin, Chlorinated hydrocarbons, Fate of pollutants, Benthic fauna, Pesticides, Dredging.

Nereis virens, a polychaete worm, concentrated polychlorinated biphenyls (PCB), as Aroclor 1254, in direct proportion to the PCB concentration in spiked sandy sediment (0.03 to 0.58 mg per kg, representative of lightly contaminated sediments) and to exposure time. Uptake was inversely porportional to worm size. Concentration factors at 32 days exposure ranged from 10.8 for 0.6 g worms to 3.8 for 4.7 g worms. A 26 day post-exposure period produced no obvious excretion of PCBs. For Crangon Septemspinosa, a shrimp, PCB concentration relationships were similar--directly proportional to concentrations in sediments and inversely related to animal size. Concentration factors at 32 days were 3.5 for 0.1 g shrimp to 1.9 for 2.9 g shrimp. Field collected N. virens (1.3-20.0 g) contained PCB, DDT, and dieldrin; smaller animals had greater levels than larger animals. During 28 days exposure to sandy sediment with *.32 mg per kg mixed Aroclors, N. virens accumulated 1.38 micrograms PCB per g. C. septemspinosa expoed to muddy sediment with 0.32 mg per kg mixed Aroclors accumulated 0.28 micrograms PCB per g; Glycera dibranchiata, 0.46 micrograms PCB per g. (Cassar-FRC)
W81-05869

**MICROBIAL DEGRADATION OF AROMATICS AND SATURATES IN PRUDHOE BAY CRUDE OIL AS DETERMINED BY GLASS CAPILLRY GAS CHROMATOGRAPHY,**
Alberta Univ., Edmonton. Dept. of Microbiology.
For primary bibliographic entry see Field 5G.
W81-05877

**WATER HARDNESS IN RELATION TO CADMIUM ACCUMULATION AND MICROSCOPIC SIGNS OF CARDIOVASCULAR DISEASE IN HORSES,**
Karolinska Inst., Stockholm (Sweden). Dept. of Environmental Hygiene.
For primary bibliographic entry see Field 5C.
W81-05937

**PERSISTENCE OF BRINE POLLUTION IN FRESNO, CALIFORNIA AQUIFER, 26 YEARS LATER,**
Fresno County Dept. of Health, CA.
J. A. Krancher, C. R. Auerheimer, G. Bisel, Jr., and K. D. Schmidt.
Journal of Environmental Health, Vol 43, No 6, p 314-318, May/June, 1981. 2 Fig, 4 Tab, 9 Ref.

Descriptors: *Brines, *Groundwater pollution, Aquifers, Water pollution, Groundwater movement, Base flow, Plume, Groundwater management, Industrial wastes, Wastewater treatment, Wastewater pollution, Wastewater management, Sodium, Chloride, Railroad yard wastes, Fresno, California.

In 1953 a source of groundwater pollution was discovered at the Southern Pacific Railroad yard, where an ice plant and water softening operation operated in Fresno, California. The area affected by the pollution was located outside the city limits on the northwest fringes of Fresno in the San Joaquin Valley. Although this major source of pollution was closed, this case study indicates that, once polluted, it may take decades for a portion of an aquifer to be rehabilitated, in spite of surface recharge and almost 30 years of continuous water extraction by pumping. The process used at the ice plant called for the cooling of brine, which was then used to freeze water to make ice for refrigerator train cars. Pits and wells were needed for the disposal process due to the presence of a nearly impermeable iron-silica hardpan near the land surface, which precluded the use of percolation ponds. The water softening operation used sodium zeolite processes in which pumped groundwater was softened and used for locomotive boiler feed water. The spent zeolite was regenerated by washing with a mixture of saturated sodium chloride solution and well water. Wastewater from backflushing and regeneration was discharged to a sump and from there to a seepage pit. In 1953 the contamination plume extended about 80 hectares, with maximum chloride and sodium levels of 840 and 418 mg/liter, respectively. In 1979 the plume covered an area of 325 ha, with highest chloride and sodium concentrations being 490 and 188 mg/liter, respectively. The rate of groundwater flow, calculated on the basis of the advance of the contaminated front, was about 61 meters per year, which is in close agreement with estimates based on water level slope and aquifer parameters. (Baker-FRC)
W81-05960

**ADSORPTION, DESORPTION, SOIL MOBILITY AND AQUEOUS PERSISTENCE OF FENSULFOTHION AND ITS SULFIDE AND SULFONE METABOLITES,**
Department of Agriculture, London (Ontario). Research Inst.
J. R. W. Miles, B. T. Bowman, and C. R. Harris.
Journal of Environmental Science and Health, Part B, Vol 16, No 3, p 309-324, 1981. 4 Fig, 4 Tab, 12 Ref.

Descriptors: *Degradation, *Fensulfothion, *Adsorption, *Insecticides, Pesticides, Muck soils, Organic matter, Solubility, Sedments, Sand.

Laboratory studies were conducted on the adsorption of fensulfothion on three soils and a stream sediment. The adsorption K values for fensulfothion in soils were as follows: sand, 1.46; stream sediment, 3.49; sandy loam, 8.39; and muck soil, 59.92. Solubilities in water (micrograms per ml) were fensulfothion, 2000; fensulfothion sulfone, 74.6; and fensulfothion sulfide, 3.70. Adsorption and water solubility were inversely related. K values for the compounds decreased in the following order: f. sulfide > f. sulfone > fensulfothion. However, below a concentration of 16.63 nanomoles per ml, f. sulfone showed less adsorption than fensulfothion on sand. There was a close correlation between organic matter content in the soils and increasing adsorption and desorption, the muck soil having the greatest adsorption and least desorption. The least water-soluble f. sulfide desorbed least readily, whereas desorption properties of fensulfothion and f. sulfone were similar to each other in all the soils. Mobilities in the soils were directly related to water solubility, fensulfothion being the most mobile. Mobility was least in the muck soil. The persistence of fensulfothion in sterile and non-sterile natural water was similar, suggesting that chemical, rather than microbial degradation was the probable mechanism. About 50% remained at the end of 16 weeks. Under reducing conditions (1% ethanol in natural water) fensulfothion disappeared in 8-12 weeks, with almost complete conversion to the sulfide. (Cassar-FRC)
W81-05963

**UPTAKE AND ELIMINATION OF 65ZN IN THE BLACK SEA IDOTEA BALTICA BASTERI,**
Institute of Biology of the Southern Seas, Sevastopol (USSR).
For primary bibliographic entry see Field 5C.
W81-05968

**MERCURY ACCUMULATION IN AND GROWTH RATE OF RAINBOW TROUT, SALMO GAIRDNERI, STOCKED IN AN EASTERN OREGON RESERVOIR,**
Oregon State Univ., Corvallis. Dept. of Agricultural Chemistry.
G. R. Phillips, and D. R. Buhler.
Archives of Environmental Contamination and Toxicology, Vol 9, No 1, p 99-107, January, 1980. 2 Fig, 3 Tab, 29 Ref.

Descriptors: *Mercury, *Trout, *Accumulation, Path of pollutants, Growth rates, Rainbow trout, Fish, Antelope Lake, Oregon.

Mercury concentrations in lateral muscle tissue from rainbow trout (Salmo gairdneri), stocked in Antelope Lake, Oregon, increased linearly during the first 5 months, leveled off during the next 3

months, and became nearly asymptotic at 8 months (0.9 micrograms per fram). This reservoir had been contaminated with Hg during gold mining activities in the 1860's. Muscle tissue of fish living in the reservoir for 7, 19, and 31 months contained similar levels of Hg, 1.1 to 1.4 micrograms per gram, indicating that the uptake curve remains asymptotic indefinitely. An estimated 0.05 micrograms Hg per liter as methylmercury would account for the methylmercury accumulation by trout in the reservoir. Growth rates (in mg per gram per day) of trout ranged from 0.7 in December to 39.7 in April, resulting in food consumption rates ranging from 25 to 140 mg per gram per day. (Cassar-FRC)
W81-05975

**TOTAL POLLUTION LOADS CONSIDERING URBAN STORM RUNOFF,**
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
A. Goettle, and K. Krauth.
Water Science and Technology, Vol 13, No 3, p 155-173, 1981. 9 Fig, 11 Tab, 22 Ref.

Descriptors: *Urban runoff, *Storm water, *Combined sewer overflows, Runoff, *Pollution load, Wastewater treatment, Storm runoff, Water pollution control, Air pollution, Fallout, Sewer separation.

A review of previous studies on storm water pollution is presented. The three main sources of this pollution are atmospheric washout and fallout (chemical composition and amount vary greatly), washoff of ground surface pollution (debris, chemicals, ice control substances, vehicle lubrication losses, degraded road surfaces, and degraded auto tires), and deposit and scour of pollutants in the sewers (observed mainly in combined sewers). Tables and figures give statistics for concentrations of various pollutants in rainfall, runoff, and sewerage, with emphasis on cities in the Federal Republic of Germany. Analysis of the data produced the conclusions that storm water pollution cannot be neglected in either separate storm sewer systems or combined sewer systems. In combined sewer systems, storage basins should be designed to capture the first flush after a storm event. In urban areas with separate sewers, all improper connections between sanitary and storm sewers must be repaired. Where there is significant surface pollution, storm runoff should be directed to the sanitary sewer for routing to the treatment plant. In residential areas with no unusual pollution, storm water treatment is not necessary. If the wastewater treatment plants cannot handle the periodic heavy loads caused by storm water, they should be improved. (Cassar-FRC)
W81-05980

**CLEARCUTTING PATTERNS AFFECT NITRATE AND CALCIUM IN STREAMS OF NEW HAMPSHIRE,**
Northeastern Forest Experiment Station, Durham, NH.
For primary bibliographic entry see Field 4D.
W81-05984

**CHANGES IN SOIL WATER QUALITY RESULTING FROM THREE TIMBER CUTTING METHODS AND THREE LEVELS OF FIBER UTILIZATION,**
Montana Univ., Missoula. School of Forestry.
N. Stark.
Journal of Soil and Water Conservation, Vol 35, No 4, p 183-187, July/August, 1980. 6 Tab, 14 Ref.

Descriptors: *Water quality, *Forest management, Forest watersheds, Cutting management, Soil water, *Clear-cutting, Logging, Forest hydrology, Iron, Soil chemistry, Nutrients, Acidity, Acidic soils, Forest soils, *Water pollution control.

A study was initiated in the Intermountain Forest and Range Experimental Region to examine the impacts of three timber cutting methods and three levels of use on the ecosystem. The cutting methods were clearcutting, understory removal, and overstory removal. Utilization levels included heavy use to 2.54 centimeters, slash broadcast burned, and slash left. In general the least damaging treatment in terms of soil water nutrients was that which left the slash where it lay. In some cases with heavy utilization, which is the removal of all live tree material, slightly elevated levels of soil water nutrients from needle decay were noted. In general, however, this treatment had only minor impacts on soil water quality over the first two years following harvest. The burning of what was left reduced the amount of iron in soil water, indicating that the burns were hot enough to alter the soil pH and iron solubility. Other ions in the soil were increased after burning. The biological lives of these soils, or the length of time that the soil can chemically support trees under identical treatments on a 70 yr rotation, are very long, mostly in excess of 40,000 yr. This is of little management importance, but the amount of available nutrients points to a risk of nutrient shock if more than wood or bark is removed from the site. Depleted supplies of copper and sodium will ultimately limit growth on these soils if iron toxicity does not do so (Baker-FRC)
W81-05988

**MASS TRANSPORT. 2. ANALYSIS OF UNCERTAINTY IN PREDICTION,**
Utah Univ., Salt Lake City. Dept. of Geology and Geophysics.
L. Smith, and F. W. Schwartz.
Water Resources Research, Vol 17, No 2, p 351-369, April, 1981. 20 Fig, 5 Tab, 16 Ref.

Descriptors: *Groundwater movement, *Stochastic process, Model studies, *Mass transport, Mathematical studies, Probabilistic process, Flow, Porous media, Soil porosity, Porosity, Capillary water, Path of pollutants, Tracers, Prediction.

The major objective of this paper is to extend the description of a stochastic modeling concept for mass transport to transport in a groundwater basin with layering, hydraulic anisotropism, chemical processes, and tracer or contaminant input functions of a more realistic character. The paper also attacks the problem of uncertainty in transport predictions. The issue of how much confidence should be placed in predictions made with mathematical models is considered. In this study it is assumed that the stochastic model describing the spatial variability and its parameter values are known without uncertainty. The results of this study indicate that transport is influenced in a complex way by geological layering, within-layer heterogeneities in hydraulic conductivity and porosity, porous medium-fluid interactions, location of the input zone, and release rate of mass from primary containment. Parameters which are capable of changing both the magnitude and direction of advective transport are of primary importance in determining prediction uncertainties. The arrangement of units with different mean hydraulic conductivities, standard deviation and integral scales in hydraulic conductivity, and hydraulic anisotropy can be identified in this respect. Other parameters such as porosity and processes such as cation exchange act only to change the magnitude of the velocity. Thus, spatial variations in these parameters are of secondary importance in contributing to uncertainty. (Baker-FRC)
W81-05998

**DISTRIBUTION OF RIBONUCLEIC ACID COLIPHAGES IN KOREA,**
Keio Univ., Tokyo (Japan). Dept. of Molecular Biology.
S. Osawa, K. Furuse, M. S. Choi, A. Ando, and T. Sakurai.
Applied and Environmental Microbiology, Vol 41, No 4, p 909-911, April, 1981. 2 Tab, 11 Ref.

Descriptors: *Path of pollutants, *Domestic wastes, *Bacteriophage, Bacterial analysis, *Korea, Geography, Coliforms, Bacteria, Viruses, Waste water, Sewage bacteria, Isolation.

Sewage samples from domestic wastes of densely populated urban areas of Korea were collected to determine the geographical distribution of ribonucleic acid (RNA) coliphages. Of the 132 samples collected from July through August of 1979, 74 (56%) were positive for RNA phages. Phages were grouped I, II or III (4:47:55) based on serological analysis. Analysis of previous data from Japan and Southeast Asia showed that the distribution pattern of RNA phages in Korea was of a type intermediate between those found in these two areas. Isolation patterns of RNA phages in Korean domestic waste samples showed a high frequency of concurrent occurrences of RNA phages of different groups or subgroups in the same sewage sample. A gradual increase in group III phages over group II phages with progressive movement away from Japan proper towards the south was noted. (Geiger-FRC)
W81-06011

**TOXICOLOGICAL EFFECTS OF AERIAL APPLICATION OF MONOCROTOPHOS,**
CIBA-GEIGY of India Ltd., Bombay.
For primary bibliographic entry see Field 5C.
W81-06027

**UREASE ACTIVITY IN TROPICAL RICE SOILS AND FLOOD WATER,**
International Rice Research Inst., Los Banos, Laguna (Philippines).
K. L. Sahrawat.
Soil Biology and Biochemistry, Vol 12, No 2, p 195-196, 1980. 2 Tab, 9 Ref.

Descriptors: *Fate of pollutants, *Assays, *Flood water, *Ureas, Fertilizers, Nitrogen compounds, Agricultural chemicals, *Rice, Salinity, Tropical regions, Alkalinity, Water analysis, Soil analysis.

The urease activity of flood water and soil used for rice growing was studied to distinguish the urease hydrolyzing power of flood water from that of the soil. Urea is the most commonly used nitrogen fertilizer in the rice paddies of the tropics. Surface, air dried and ground samples of 13 different soils were examined for urease activity by a modified non-buffer technique using a potassium chloride extraction and steam distillation with magnesium oxide. Urease activity in flood water was determined in a similar manner, with corrections for ammonium ions present in raw samples. Urea hydrolysis in soil varied from 8.0 to 32.0 micrograms of ammonium ion formed/hour/g soil at 30 degrees. Alkali increased the rate of soil urease activity in both soil and water samples, while salt had little effect. Urease activity in flood waters of 11 lowland rice soils varied from 0 to 36 micrograms of ammonium ion formed/25 ml/hour. Differences in results between the present and previous studies were attributed to different test conditions from studies done in the field and laboratory and from those afforded by greenhouse environments. (Geiger-FRC)
W81-06037

## 5C. Effects Of Pollution

**SURVEY OF AQUATIC WEEDS AND ALGAE IN WELLTON-MOHAWK MAIN CONVEYANCE CHANNEL-GILA PROJECT; FINAL REPORT 1979-80,**
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
N. E. Otto, and V. S. Miyahara.
Report GR-81-7, January, 1981. 74 p, 9 Fig, 1 Tab, 7 Ref, 2 Append.

Descriptors: *Aquatic weeds, *Aquatic productivity, *Diatoms, *Drainage water, Drainage canals, Aquatic plants, Conveyance structures, Desalination plants, Nitrogen, Phosphorus, Water pollution effects, Aquatic weed control.

Algae growing in the Wellton-Mohawk main conveyance channel drainwater were monitored weekly from 1978 through March 1980. The dominant algae continued to be diatoms, as previously reported in 1976 and 1978. These diatoms are known to be predominantly epiphytic forms that grow on the canal lining and other substrate, and are torn loose by waterflow and become free-floating plankton. Algal cell counts over this period ranged of approximately 4,500 cells/mL in

January 1980 to a maximum count of approximately 45,000 cells/mL in April of 1979. The measured drift was predominantly aquatic weeds, filamentous algae, and terrestrial debris, averaging approximately 2300 kg wet weight per 24 hours with a maximum of approximately 6000 kg per 24 hours. Environmental parameters in the drainwater, such as the nitrogen and phosphorus levels, were studied. A combination of conditions appears to be responsible for changes in aquatic vegetation productivity. The data indicate that removal of weeds by maintenance is directly related to the amount of vegetational debris found downstream. These biological data were used in part to aid in the design and development of operating criteria for the 394000 cu m/day desalting plant to be sited on the canal as part of the Colorado River Basin Salinity Control Project. (Moore-SRC)
W81-05742

**ECOLOGY OF CATOSTOMIDS IN TWIN LAKES, COLORADO, IN RELATION TO A PUMPED-STORAGE POWERPLANT,**
Colorado Cooperative Fishery Research Unit, Fort Collins.
D. A. Krieger.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-240582, Price codes: A04 in paper copy, A01 in microfiche. Bureau of Reclamation, Engineering and Research Center Report REC-ERC-80-2, June, 1980. 56 p, 14 Fig, 21 Tab, 48 Ref, 2 Append.

Descriptors: *Pumped storage, *Environmental effects, *Sucker, *Powerplants, Larvae, Turbidity, Ecology, Growth, Fish populations, Fish food, Entrainment, *Baseline studies, *Twin Lakes, Colorado.

Growth, food habits, reproductive biology, distribution, and survival of white and longnose suckers in Twin Lakes, Colorado, were investigated during 1978 to define the role of these species in relation to the sport fishery and to provide baseline information prior to operation of a pumped-storage powerplant being constructed on the northwest shore of the lower lake. White suckers were longer lived and slower growing than suckers in other areas. Longnose suckers were also slow growing but few lived past 8 years. Food of the suckers was predominantly chironomid larvae, fingernail clams, and cladocera. Utilization of a more diverse diet by fish in the lower lake was attributed to food availability and more food competition than in the upper lake. Distribution of the fish was affected by size and season. White suckers were often captured more than 2 m off the bottom. Densities of white suckers were greater in the lower lake. Longnose suckers were relatively abundant at the powerplant; however, few white suckers were captured near the site. Entrainment of adult suckers could be greater at night due to inshore movements of the fish at that time. Larval suckers were not prevalent near the powerplant, but may be swept into the area by currents created during the pumping mode. The indirect effects of operation of the powerplant on the suckers may include: turbidity effects on food organisms; turbidity effects on feeding; chumming with remains of entrained fish, mysids, and zooplankton; and alteration of the trophic dynamics of the ecosystem. (Moore-SRC)
W81-05744

**ENVIRONMENTAL ASPECTS OF DREDGED MATERIAL DISPOSAL RELATING TO WATERWAY DEVELOPMENT,**
For primary bibliographic entry see Field 6G.
W81-05753

**THE MOLLUSCAN SHELL: BIOLOGICAL RECORD OF ENVIRONMENTAL CHANGE,**
Yale Univ., New Haven, CT. Geology and Geophysics.
D. C. Rhoads, and R. A. Lutz.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-159816, Price codes: A15 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-019, March, 1981. 4 p.

Descriptors: *Mollusks, *Environmental effects, *Environmental quality, *Water pollution effects, Water quality, Sediments, Shellfish, Salinity, Water temperature, Mortality, Storms, Benthic environment, Benthic organisms.

The responses of benthic organisms to temporal and spatial changes in environmental quality cannot always be directly measured. The effect of a storm, pollution event, change in salinity, temperature, or sediment type may be assessed with a species population after the event or change. This manual of molluscan shell growth has been prepared so that the pollution biologist can extract information about recruitment, growth, and mortality responses of molluscs to past and present changes in environmental quality. Information is stored within invidual molluscan shells in the form of ontogenetic records of growth and development. Environmental changes may be recorded in the skeleton as a change in shell shape and form, microgrowth increments, shell microstructure, mineralogy or chemistry. A specific environmental change may involve one or several of these variables. Environmental change is also manifested at the population level in the form of temporal or spatial changes in the structure of wholeshell, size-frequency distributions of both living and death assemblages. A wide range of ecological problems can be addressed through shell research, including after-the-fact pollution studies, identification of adaptive strategies, and shellfisheries management. (Moore-SRC)
W81-05757

**AEROBIC MICROBIAL ACTIVITY IN SURFACE SEDIMENTS CONTAINING HIGH OR LOW CONCENTRATIONS OF ZINC TAKEN FROM DUBLIN BAY, IRELAND,**
Trinity Coll., Dublin (Ireland). Dept. of Microbiology.
A. H. Pickaver, and M. C. Lyes.
Estuarine, Coastal and Shelf Science, Vol 12, No 1, p 13-22, 1981. 3 Fig, 5 Tab, 23 Ref.

Descriptors: *Sediments, *Zinc, *Microorganisms, Intertidal areas, Heavy metals, *Aerobic bacteria, Bacteria, Coastal waters, Metabolism, Marine sediments, *Ireland, *Dublin Bay, Water pollution effects.

The finding of an earlier study, showing that some areas of Dublin Bay in Ireland had high levels of zinc, raised concerns about the ability of the Bay to accept the large quantities of domestic sewage effluent it receives. This study was designed to determine the viable numbers and biomass of aerobic bacteria in surface sediments from polluted and non-polluted sites, to compare the oxygen uptakes of these bacteria, to determine any effect of zinc on the in situ cellulose degradation, and to examine the zinc resistance profiles of these microorganisms. Both viable counts of free, unattached bacteria and measurement of total biomass using the muramic acid method showed that bacterial numbers were about 15 times higher in the polluted sites than in the non-polluted site. Metabolic rates appeared to be between two and four times higher in the polluted site when measured by oxygen consumption or by cellulose degradation, when computed in terms of dry weight of sediment per unit time. However, when computed in terms of bacterial numbers per unit time, the true metabolic rate in the polluted sediment was found to be five times lower than in the non-polluted sediment. Bacteria within sediments of the Bay exhibited a range of resistance to zinc, but the percentage of zinc-resistant bacteria appeared to increase inversely to the concentration of zinc in situ. There appeared to be no selection for a particular zinc-resistant bacterial population during the metabolism of cellulose as a specific carbon source. (Carroll-FRC)
W81-05767

**EFFECTS OF FLUCTUATING, SUBLETHAL APPLICATIONS OF HEAVY METAL SOLUTIONS UPON THE GILL VENTILATORY RESPONSE OF BLUEGILLS (LEPOMIS MACROCHIRUS),**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
J. Cairns, Jr., K. W. Thompson, and A. C. Hendricks.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-150997, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S3-81-003, April, 1981. 4 p, 3 Fig.

Descriptors: *Water pollution effects, *Monitoring, *Bluegills, *Fish behavior, *Computers, Heavy metals, Effluents, Toxicity, Bioassay, Statistics, Water quality management, Zinc, Copper, Nickel, Chromium.

This study demonstrates the use ofminicomputers for continuously observing the ventilatory behavior of fish in order to monitor the quality of the water passing through fish sensing chambers. The water source culd be an industrial effluent, agricultural runoff, or a carefully controlled laboratory source as in this study. Situations of complex, fluctuating toxic effluents were simulated in order to describe responses that could be expected. These results were then compared with those of control fish which were not exposed to toxic effluents. Not only did ventilatory rtes significantly increase in response to labortory effluents (sublethal concentrations of zinc, copper, mixtures of zinc and copper, and mixtures of zinc, copper, nickel, and hexavalent chromium), but also the amplitude of the ventilatory signal was reduced considerably. The fish were capable of responding similarly to repeated exposures of toxicant solutions, indicating the feasibility of an environmental monitoring system based on ventilatory behavior. the amplitude response was primarily due to a real change in ventilatory behavior of the fish, not to a change in electrical properties of the water due to the addition of the toxicant solutions. The ventilatory data met the requirements for parametric statistical analyses when comparing individuals. Thus, when sample size is large enough, conventional methods such as the analysis of variance can be employed. This is a promising system that could be developed into a useful, on-line environmental moniotr for industrial, agricultural, or other purposes. (Brambley-SRC)
W81-05770

**NATIONWIDE ASSESSMENT OF RECEIVING WATER IMPACTS FROM URBAN STORMWATER POLLUTION; VOLUME 1, SUMMARY,**
Florida Univ., Gainesville.
J. P. Heaney, W. C. Huber, and M. E. Lehman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-161812, Price codes: A08 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-025, March, 1981. 4 p.

Descriptors: *Urban runoff, *Storm runoff, *Water pollution sources, Urban areas, Pollutants, Water quality standards, Environmental effects, Dissolved oxygen, Combined sewer overflos, Sediments.

A search through published and unpublished literature on urban wet-weather impacts on receiving waters yielded information for each of the 248 urbanized areas in the United States. The information was analyzed in terms of: characteristics of the urban area as it related to types and quantitites of pollutants; characteristics and types of receiving waters; uses of receiving waters and water quality standards; kind of impact and its characteristics; and key pollutant or pollutants. Impacts on receiving waters were not clearly defined, since they are a composite of the perspectives of many professionals, and the waters themselves are not well defined. Almost 85% of the receiving waters are rivers, with lakes - 5%, and estuaries and oceans - 10%. Very few fish kills identify urban runoff as the direct cause, but it could be a cause in up to 50% of the beach closings. Reduced dissolved oxygen levels may be due to combined sewer overflows, urban runoff, and sediment resuspension, but also to failures in treatment plants and even accidental or deliberate discharges from point sources. Of the 19 cities having more than four

urban runoff problem citations, over half are the older cities of the northeast. (Brambley-SRC)
W81-05772

**MODIFICATIONS OF MODELS PREDICTING TROPHIC STATE OF LAKES: ADJUSTMENT OF MODELS TO ACCOUNT FOR THE BIOLOGICAL MANIFESTATIONS OF NUTRIENTS,**
Environmental Monitoring Systems Lab., Las Vegas, NV.
S. C. Hern, V. W. Lambou, L. R. Williams, and W. D. Taylor.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-144362, Price codes: A03 in paper copy, A01 in microfiche. Project Summary EPA-600/S3-81-001, February, 1981. 2 p.

Descriptors: *Models, *Trophic leve, *Eutrophication, *Nutrients, *Phosphorus, Phytoplankton, Lakes, Biomass, Chlorophyll, Prediction, Limiting factors, Lake classification, Water quality management.

The strong relationship between total phosphorus and phytoplankton biomass in lakes has been confirmed. What is now needed to predict algal biomass for making better management decisions for individual lakes is a quantitative understanding of the range in biomass (as measured by chlorophyll a) per unit of phosphorus. This range extends over several orders of magnitude. To determine the environmental factors affecting the response of phytoplankton chlorophyll a to total phosphorus concentration, collected data from 757 U.S. lakes were analyzed showing that light attenuation from interferences not related to chlorophyll a can dramatically affect the quantity of phytoplankton biomass in many U.S. lakes. The ratio of biologically available phosphorus to nitrogen is, in some cases, an important factor in determining the amount of chlorophyll a produced per unit of phosphorus present. This report presents methods to modify nutrient ambient-and loading-models that predict the trophic state of lakes to: change the trophic classification based on an ambient total phosphorus level to one based on the biological manifestation of nutrients as measured by chlorophyll a; allow determination of the critical levels of phosphorus that will result in unacceptable levels of chlorophyll a; and account for the unique characteristics of a lake that affect the amount of chlorophyll a produced per unit of phosphorus. If chlorophyll a is used as the trophic classification criterion rather than total phosphorus, many U.S. lakes would be classified lower, i.e., less eutrophic.
W81-05778

**METALS IN SEAFOOD ORGANISMS NEAR A LARGE CALIFORNIA MUNICIPAL OUTFALL,**
Southern California Coastal Water Research Project, Long Beach.
D. R. Young, M. D. Moore, T-K. Jan, and R. P. Eganhouse.
Marine Pollution Bulletin, Vol 12, No 4, p 134-138, April, 1981. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Trace metals, *Marine animals, *Waste water outfall, Municipal wastes, Fish, Shellfish, Sediments, Abalone, *Los Angeles, California, Water pollution sources, Water pollution effects.

The degree to which bottom-feeding seafood organisms collected in a municipal waste water outfall area have accumulated trace metals above natural levels was determined. Elevated concentrations of eight trace metals were found in surficial sediments off the Palos Verdes Peninsula, site of the Los Angeles County outfall system. In five popular, benthic-feeding sportfishes, the metals were not found in excess of levels measured in island and coastal control spcimens, with the possible exception of copper and zinc. Elevations above control values did occur for edible tissue (muscle except for sea urchin gonads) of benthic invertebrates. A 10-fold elevation in abalone and scallop represented the maximum contamination level observed. In most other cases, median concentrations did not exceed controls by more than a factor of two or three. It isj possible that the marine fishes and invertebrates in the study have evolved mechanisms to limit the bioaccumulation of metals when exposed to high levels in sediments. (Small-FRC)
W81-05834

**METALS IN MARINE SEDIMENTS NEAR A LARGE CALIFORNIA MUNICIPAL OUTFALL,**
Southern California Coastal Water Research Projct, Long Beach.
G. P. Hershelman, H. A. Schafer, T-K. Jan, and D. R. Young.
Marine Pollution Bulltin, Vol 12, No 4, p 131-134, April, 1981. 2 Fig, 4 Tab, 12 Ref.

Descriptors: *Trace metals, *Bottom sediments, *Waste water outfall, Water pollution effects, Sedimentology, Sediments, Arsenic, Cadmium, Chromium, Copper, Mercury, Los Angeles, California, Municipal wastes.

The contamination of bottom sediments in a municipal outfall region by eight trace metals was determined. Elevated concentrations of trace metals were found in surficial sediments off Palos Verdes Peninsula, site of the Los Angeles County outfall system. Treated industrial and domestic waste water is discharged here. Contamination factors were calculated by dividing the median outfall value by the median baseline value. In the 45 sq km outfall monitoring zone the following contamination factors were found: Ag 27, Cd 36, Cr 12, Cu 20, Hg 23, Ni 5.4, Pb 17, and Zn 7.7. The discharge of municipal waste water via submarine outfalls is the dominant source of most toxic metals to the southern California coastal marine ecosystem. Studies on the fate of waste water particles and on the biological availability of waste water metals in the marine environment are underway. (Small-FRC)
W81-05835

**THE STRUCTURE AND COMPOSITION OF EPILITHIC DIATOM COMMUNITIES OF THE ST. LAWRENCE AND OTTAWA RIVERS IN THE MONTREAL AREA,**
McGill Univ., Montreal (Quebec). Marine Sciences Centre.
M. A. De Seve, and M. E. Goldstein.
Canadian Journal of Botany, Vol 59, No 3, p 377-387, 1981. 8 Fig, 4 Tab, 34 Ref.

Descriptors: *Rivers, *Diatoms, Algae, *Benthic flora, Population density, Aquatic populations, Canada, Saint Lawrence River, Ottawa River, *Water pollution effects.

Very few studies have been conducted of the flora of the St. Lawrence River, even though it is one of the largest rivers in Canada and the main source of both domestic and industrial water for the city of Montreal. This study investigated the structure and composition of epilithic diatom communities and their seasonal variations in relation to certain physical and chemical parameters of the water at five stations in the St. Lawrence River and one station in the Ottawa River. One hundred and thirty-nine species and varieties of Bacillariophyceae were identified in the diatom flora from these stations. The species composition generally reflected an autrophic and organically polluted environment. The six stations were similar with respect to temperature and pH, but differed with respect to total dissolved solids, alkalinity, and silica concentrations. However, the pattern of seasonal variation for each of these chemical parameters was generally the same for all stations. The structures of the diatom communities on the Ottawa River and upstream and downstream on the south side of the island of Montreal were found to be similar with respect to number of species, species richness, Shannon-Weiner information measure of diversity, biomass, and, to a certain extent, density. The community structures at these four stations do not reflect the physical and chemical differences between the locations nor the increase in the number of sewage outlets above the stations furthest downstream. The fifth station, located on the east side of the island and further downstream from the first four stations, had fewer species, and its species richness and Shannon-Weiner information measure of diversity differed significantly from that of other stations, probably due to the presence of oil refinery pollution. The sixth station, furthest downstream, had a significantly lower biomass and a significantly lower density than the other stations. The reasons for these differences are not known at this time. (Carroll-FRC)
W81-05855

**RELATIONSHIP OF MORTALITY OF AQUATIC BIOTA FROM 96-HOUR SEDIMENT BIOASSAYS AND THE CHANGE IN CHEMICAL COMPOSITION OF THE TEST WATER,**
Aqua Tech Environmental Consultants, Inc., Melmore, OH.
R. A. Laskowski-Hoke, and B. L. Prater.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 3, p 323-327, March, 1981. 1 Tab, 24 Ref.

Descriptors: *Bioassay, *Sediments, *Dredging, *Lake Michigan, Aquatic life, Mortality, Chemical analysis, Invertebrates, Correlation analysis, Water analysis, Ecological effects.

The 96-hour sediment bioassay test was evaluated as a procedure for determining the effects of dredged materials on squatic life. In addition, bulk and elutriate chemical analyses were conducted as well as analysis of pre-test and post-test water. The mortality data were correlated with chemical changes in the water. Biota used were Pimephales promelas Rafinesque, Hexagenia limbata Walsh, Lireceus fontinalis Rafinesque, and Daphnia magna Straus. Chemical parameters analyzed were suspended solids, nitrate-nitrite, ammonia, total Kjeldahl nitrogen, total P, ortho P, chloride, chemical oxygen demand, As, Cd, Cr, Cu, cyanide, Fe, Pb, Mn, Hg, Ni, and Zn. Of the 76 bivariate correlations performed, 14 were considered potentially meaningful. These were: suspended solids, Cd, Cr, and Hg, for H. limbata; nitrate-nitrite, total Kjeldahl N, and total P, for P. promelas; ammonia for P. promelas, H. limbata, and L. fontinalis; and cyanide and Zn for H. limbata and D. magna. Reasons for the correlations are proposed. The sediment bioassay tests coupled with difference chemical analysis enable and investigator to assess the impacts of the sediments on indigenous organisms and to examine potential leaching effects from the sediment. (Cassar-FRC)
W81-05859

**LONG-TERM EFFECTS OF INTENSIVE PESTICIDE APPLICATIONS ON THE AQUATIC COMMUNITY IN ORCHARD DRAINAGE DITCHES NEAR HAMBURG, GERMANY,**
Hamburg University (Germany, F.R.). Inst. fuer Hydrobiologie und Fischereiwissenschaft.
C. W. Heckman.
Archives of Environmental Contamination and Toxicology, Vol 10, No 4, p 393-426, July, 1981. 1 Fig, 5 Tab, 41 Ref.

Descriptors: *Pesticides, *Ecological effects, *Aquatic animals, Water pollution effects, Aquatic habitats, Ditches, Orchards, Drainage ditches, Biological communities, Aquatic life, Aquatic plants, Distribution patterns, Species composition, Toxicity, Herbicides, Insecticides, Invertebrates, Oligochaetes, Crustaceans, Insects, Agricultural chemicals.

The structures of aquatic communities in orchard drainage ditches intensively sprayed with pesticides for 25 years were compared with communities existing in the early pesticide-use era, described in a 1961 study by Garms. Floral species diversity was little affected by herbicide application. Some spcies of macrofauna have been eliminated and many have become resistant to the agricultural chemicals. Disappearance of some predatory species and competitors also allowed preyed-upon species to increase. Species showing no harmful effects from 25 years of chemical applications in the orchards are: Porifera, Turbellaria, Plumatella fungosa, Oligochaeta, leeches (with the exception of fish leeches), Sphaerium corneum, aquatic spiders, Heteroptera, some Lepidoptera, Diptera, and Vertebrata. Those adversely affected or eliminated are fish leeches, Gastropoda, most

bivalve species, Acari, Odonata, Neuroptera, Trichloptera, and Coleoptera. Spcies diminished or eliminated for reasons other than pesticide application are Lephopus crystallinus and Ephemeroptera. Collembola are still abundant after 25 years, but species composition is different. Crustaceans are difficult to judge because they exhibit bloom and collapse population dynamics. The 30 pesticides used extensively in this region are listed and described. Sequential application of pesticides allows species to develop resistant populations, whereas combined application tends to eliminate species more readily. (Cassar-FRC)
W81-05870

**ACUTE TOXIC RESPONSES OF THE FRESHWATER PLANARIAN, DUGESIA DOROTOCEPHALA, TO CHLORDANE,**
Colorado State Univ., Fort Collins. Dept. of Physiology and Biophysics.
J. B. Best, M. Morita, and B. Abbotts.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 4, p 502-507, 1981. 4 Fig, 11 Ref.

Descriptors: *Platyhelminthes, *Bioassays, *Water pollution effects, *Chlordane, Aquatic animals, Water pollution, Pollutant identification, Pesticides, Insecticides, Pesticide toxicity, Toxicity, Planaria.

Planaria are easy to culture in the laboratory and may serve as an economical organism for bioassays in screening for aquatic pollution by the pesticide, chlordane. Planaria (Dugesia dorotocephala) were exposed to various concentrations of chlordane in glass bowls, and toxicity was assessed by the development of head lesions. The five-day LC50 was found to be between 5 and 10 ppm, while a ten-day LC50 was calculated to be between one and five ppm. Latency increased and the rate of increase in incidence decreased with decreasing chlordane levels. Low levels of chlordane increased the incidence of fissioning above control values, while higher levels of chlordane reduced fissioning. Although the present study used chlordane in a commercial emulsifiable preparation, possible potentiation of toxicity by the other components was not accounted for. (Geiger-FRC)
W81-05871

**DISTRIBUTION OF ZOOPLANKTON POPULATIONS WITHIN AND ADJACENT TO A THERMAL PLUME,**
Michigan Univ., Ann Arbor. Great Lakes Research Div.
M. S. Evans.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 4, p 441-448, April, 1981. 5 Fig, 2 Tab, 20 Ref.

Descriptors: *Heated water, *Predation, *Zooplankton, *Distribution patterns, Thermal pollution, *Lake Michigan, Cooling water, Fish, Water pollution effects, Population density, Plumes, Thermal pollution, *Nuclear powerplants, Powerplants, Lakes, Donald Cook Nuclear Power Plant.

Zooplankton distributions in the upper 1 meter layer differed between ambient waters and the thermal plume produced by the Donald C. Cook Nuclear Power Plant on southeast Lake Michigan. Zooplankton were most abundant in the warmest waters of the plume (maximum recorded temperature 21.7 C in September 1976 and 17.6 C in June 1977). The region of high density was about 800 meters long and covered 0.2 to 0.3 sq km. Upward vertical displacement of deep-dwelling plankton was the mechanism for alterations in distribution, not water temperature alone. Zooplankton in the thermal plume are exposed to increased fish predation, being more visible and less able to detect and avoid the predators. (Cassar-FRC)
W81-05874

**CANCER MORBIDITY INVESTIGATIONS: LESSONS FROM THE DULUTH STUDY OF POSSIBLE EFFECTS OF ASBESTOS IN DRINKING WATER,**
Minnesota Dept. of Health, Minneapolis.
E. E. Sigurdson, B. S. Levy, J. Mandel, R. McHugh, and L. J. Michienzi.
Environmental Research, Vol 25, No 1, p 50-61, 1981. 4 Fig, 5 Tab, 18 Ref.

Descriptors: *Asbestos, *Drinking water, *Morbidity, *Cancer, Water pollution effects, Mortality, Duluth, Minnesota, St. Paul, Minneapolis, Public health, Diseases, Human diseases, Epidemiology.

Surveillance of cancer morbidity in Duluth, Minnesota, was undertaken to investigate the effects of ingesting asbestos fibers in municipal drinking water. Tests in 1973 had revealed the presence of 1 to 30 million asbestos-like fibers per liter of tap water. Asbestos-containing taconite ore wastes were dumped into Lake Superior from 1955 to 1980, sometimes at the rate of 67,000 tons per day. Using the methods of the Third National Cancer Survey and comparing results with data collected in Minneapolis and St. Paul showed that Duluth females and both sexes combined had statistically significantly higher rates of pancreatic cancer than persons in Minneapolis and St. Paul for 1969-1971. The rates for both sexes declined during the 1972-1974 period. Morbidity and mortality rates were compared. Mortality rates in Duluth for cancers in certain gastrointestinal sites and for lung cancer were substantially higher for Duluth than for Minneapolis and St. Paul, but morbidity rates were very similar. The time requirements, budget, personnel, and supplies for conducting a morbidity study in a small (100,000) population are described. (Cassar-FRC)
W81-05881

**INFLUENCE OF THERMAL CHALLENGE ON CONDITIONED FEEDING FORAYS OF JUVENILE RAINBOW TROUT,**
Environmental Research Lab., Deluth, MN.
B. H. Munson, J. H. McCormick, and H. L. Collins.
Transactions of the American Fisheries Society, Vol 109, No 1, p 116-121, January, 1980. 3 Fig, 16 Ref.

Descriptors: *Thermal stress, *Trout, Fish, Thermal pollution, Heated water, *Thermal water, Powerplants, Industrial wastewater, Industrial effluents, Thermal powerplants, *Rainbow trout.

The study was made to determine whether a laboratory test procedure would provide useful data in predicting thermal barriers to highly motivated fish movements. Juvenile rainbow trout were conditioned to travel a 2.4 meter long channel to receive a food reward. Thermal challenges were placed along the pathway of the fish. The criterion on which conditioning was determined was that 80% of the fish would leave the safe area of the water and travel to the reward area within two minutes of their release to get food. Temperature challenges comprised successive 3C increases above acclimation or the previous challenge temperature. The fish first delayed entering the reward end of the tank when the intervening heated water was at 12-15 degrees above acclimation. As the temperature was increased above this level, the delays became progressively longer, even though complete inhibition was never achieved. Above the critical thermal maximum, the fish still achieved the reward, but died afterward. Individual vs group challenges did not change the response of the fish. When fish were exposed to temperature beyond their critical thermal maximum, without prior challenges at less stressful temperatures, they responded similarly to those receiving progressively greater challenges. (Baker-FRC)
W81-05911

**MYSIS RELICTA: EFFECTS OF TURBIDITY AND TURBULENCE ON SHORT-TERM SURVIVAL,**
Colorado Cooperative Fishery Research Unit, Fort Collins.
R. E. Gregg, and E. P. Bergersen.
Transactions of the American Fisheries Society, Vol 109, No 2, p 207-212, March, 1980. 1 Fig, 2 Tab, 8 Ref.

Descriptors: *Shrimp, *Turbulent flow, *Turbidity, Physical properties, Water currents, Riffles, Flow, Powerplants, Hydroelectric plants, *Ecological effects, Lakes.

The purpose of this experiment was to determine the effects of turbulence and turbidity on the short-term mortality of Mysis relicta under laboratory conditions that simulated lake conditions during powerplant operation. Turbulence caused a highly significant increase in mortality of Mysis relicta. A linear regression analysis of turbulence and main-effect mean mortality due to turbulence resulted in a highly significant correlation coefficient of 0.99. Neither turbidity nor the interaction of turbidity and turbulence significantly affected mortality. The higher turbidity actually seemed to improve Mysis relicta survival at the lowest level of turbulence. Higher mortality resulted from prolonged exposure to turbidity and turbulence. A linear regression analysis between time and mortality yielded a highly significant correlation coefficient of 0.99. There was a significant interaction between time and turbidity, due mainly to the large individual effects of time, as the interaction was not considered to be important. The mortality of Mysis relicta in these trials can be attributed to abrasion from container walls, damage to the organism from the shear stress of turbulent water, and exhaustion. Mysids entrained by the pumping cycle, held in a turbulent forbay and then returned to the lake during the generation cycle at a powerplant suffer increased mortalities from exhaustion and abrasion. (Baker-FRC)
W81-05923

**EFFECTS OF RECREATIONAL RIVER TRAFFIC ON NEST DEFENSE BY LONGEAR SUNFISH,**
Water and Power Resources Service, Boulder City, NV. Div. of Planning.
For primary bibliographic entry see Field 6G.
W81-05926

**HYDRAZINE: ACUTE TOXICITY TO BLUEGILLS AND SUBLETHAL EFFECTS ON DORSAL LIGHT RESPONSE AND AGRESSION,**
Aerospace Medical Research Lab., Wright-Patterson AFB, OH.
For primary bibliographic entry see Field 5A.
W81-05928

**STOCHASTIC SIMULATION OF TEMPERATURE EFFECTS ON FIRST-YEAR SURVIVAL OF SMALLMOUTH BASS,**
Toronto Univ. (Ontario). Inst. for Environmental Studies.
B. J. Shuter, J. A. MacLean, F. E. J. Fry, and H. A. Regier.
Transactions of the American Fisheries Society, Vol 109, No 1, p 1-34, January, 1980. 29 Fig, 6 Tab, 111 Ref.

Descriptors: *Water temperature, *Fish, *Bass, Stochastic process, Physical properties, Temperature, Mathematical studies, Probabilistic process, Model studies, *Thermal pollution, Temperature effects, Thermal stress, Powerplants.

An examination was made of the physiological basis for the well-known correlations between summer air temperature indices and year-class strength in northern smallmouth bass (Micropterus dolomieui) populations. The existence of two critical stages in early life was demonstrated at which smallmouth bass were particularly vulnerable to features characteristic of many natural water temperature regimes. The first stage lasts from fertilization until the young leave the nest. The extreme temperatures cause high mortality rates. The second stage extends over the first winter when the young subsist on accumulated energy reserves. Large fish can withstand winter starvation better than smaller fish. A deterministic model was made of the relations between temperature and first-year survival of smallmouth bass. A stochastic model was developed from the analysis of water temperature time series data from many locations. The model is capable of simulating variations in water

temperature characteristic of the littoral zones of typical North American lakes. The stochastic physical and biological models were used together to assess the effects on first-year survival of changes in climate and of realistic changes in the magnitude and frequency of short-term temperature fluctuations. The model predicted the observed northern limit of the species range. It also generated approximate environmental criteria for judging yearly variations in survival. The combined model assessed the effects of thermal loading from a nuclear power plant on a particular population. (Baker-FRC)
W81-05930

**WATER HARDNESS IN RELATION TO CADMIUM ACCUMULATION AND MICROSCOPIC SIGNS OF CARDIOVASCULAR DISEASE IN HORSES,**
Karolinska Inst., Stockholm (Sweden). Dept. of Environmental Hygiene.
C. G. Elinder, T. Stenstrom, M. Piscator, L. Linnman, and L. Jonsson.
Archives of Environmental Health, Vol. 35, No. 2, p 81-84, March/April, 1980. 1 Tab, 22 Ref.

Descriptors: *Cadmium, *Diseases, *Hardness, *Drinking water, Water quality, Toxicity, Horses, Animal pathology, Calcium, Magnesium, Kidneys, Accumulation, Water pollution effects, Fate of pollutants, Adsorption.

Horses living in soft water areas showed statistically more cadmium accumulation in the kidney cortex than horses living in hard water regions. More microscopic signs of arteriosclerosis and focal myocardial fibrosis were seen in horses that drank soft water than in the hard water group, but differences were not statistically significant. Considering all 50 horses (median age 14.5 years), the 25 drinking waters of <45 mg per liter hardness had 69.9 micrograms per gram wet weight Cd in the kidney cortex, and seven of the 25 had vascular changes. The 25 horses drinking water > 45 mg per liter of hardness and 54.1 micrograms per liter Cd in the kidney cortex, and three and five of 25 had myocardial and aortic changes, respectively. Eliminating the horses less than ten years old and considering 35 horses with median age 18 years showed that horses drinking soft water had 81.5 micrograms per gram Cd in the kidney cortex, and seven of 17 showed vascular changes. The 18 horses drinking hardwater had 60.2 micrograms per gram Cd, and three and two of the 18 showed aortic and myocardial changes, respectively. A possible explanation for Cd accumulation in the soft water area horses is that the soils, being generally more acid than in hard water areas, cause more effective Cd absorption by food plants and thus by the animals that consume them. (Cassar-FRC)
W81-05937

**PERSISTENCE OF BRINE POLLUTION IN FRESNO, CALIFORNIA AQUIFER, 26 YEARS LATER,**
Fresno County Dept. of Health, CA.
For primary bibliographic entry see Field 5B.
W81-05960

**ACCUMULATION AND ELIMINATION OF DDT IN THE BARENTS SEA POLLOCK (POLLACHIUS VIRENS),**
Murmanskaya Biologicheskaya Stantsiya (USSR).
V. V. Andryushchenko, and O. N. Khokhryakova.
Hydrobiological Journal, Vol 16, No 1, p 47-50, 1980. 2 Tab, 13 Ref.

Descriptors: *Pesticides, *Fish, Bioaccumulation, DDT, Seawater, Biological magnification, Accumulation, Metabolism, Excretion, Path of pollutants.

The distribution of DDT was studied in the organs and tissues of the Barents Sea pollock to establish the extent of bioaccumulation of this pesticide, and also the dynamics of its elimination following transfer of the fish to pure water, which is of some importance in relation to establishing the quantitative aspect of the detoxication process in Barents Sea fishes living at low temperatures. Under experimental conditions in running water aquaria, the bioaccumulation of DDT by the pollock increased in the sequence of muscles, gills, and liver. DDT accumulation fluctuated over time. After the fish were transferred to pure running water the concentration of the pesticide declined appreciably only in the liver. During the period of experiment no DDT metabolites were found in the water or in the organs analyzed. The metabolism of organochlorine pesticides may be slowed under low temperature conditions.(Baker-FRC)
W81-05965

**UPTAKE AND ELIMINATION OF 65ZN IN THE BLACK SEA IDOTEA BALTICA BASTERI,**
Institute of Biology of the Southern Seas, Sevastopol (USSR).
V. N. Ivanov, V. N. Yegorov, and M. M. Shevchenko.
Hydrobiological Journal, Vol 16, No 1, p 56-59, 1980. 1 Fig, 6 Ref.

Descriptors: *Marine animals, *Zinc, Metabolism, Absorption, Aquatic life, *Black Sea, Food chains, Marine algae, Isopods, Path of pollutants, Metals, Trace metals, Radioactive tracers.

The isopod Idotea baltica basteri was used to study the transfer of zinc to this organism from its food (Ulva rigida). Isopods were housed individually to study the part played by molting in elimination of the radiozinc concentrated by them. The Idotea were able to feed constantly on radioactive U. rigida. The average daily consumption was 38% of body weight for isopods with a mass of 13-20 mg. The feeding pattern of non-molting isopods did not change during the course of the experiments. Irrespective of the size of the individuals, up to 70% of the radioactivity of the food consumed in a day entered the organism of the isopods. Loss of radiozinc was accelerated by five degree increases in temperature. The metabolism of zinc proved to be an intricate process. Quantitative description of the uptake and elimination of zinc was, however, possible. The flow of zinc through individual species of marine organisms via the food is complicated by the form of the storage of the element in food organisms. (Baker-FRC)
W81-05968

**THE EFFECTS OF COAL INDUSTRY POLLUTANTS ON THE MACROINVERTEBRATE FAUNA OF A SMALL RIVER IN THE SOUTH WALES COALFIELD,**
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
J. Scullion, and R. W. Edwards.
Freshwater Biology, Vol 10, No 2, p 141-162, April, 1980. 6 Fig, 3 Tab, 80 Ref.

Descriptors: *Mine wastes, *Rivers, *Wales, Invertebrates, Industrial wastes, *Coal mines, Aquatic life, Macroinvertebrates, Fauna.

The Taff Bargoed, a tributary of the river Taff, in Wales, was examined to study the ecological effects of some types of pollution associated with the coal industry. The Taff Bargoed rises about two km east of Merthyr Tydfil in open moorland and flows south for about 12 km to its confluence with the River Taff. The valley through which the river moves is basically agricultural. The river receives three major and spatially separate sources of pollution: acid drainage, especially after heavy rainfall, from cola stockpiles near the upper reaches; pumped mine water containing high concentrations of suspended solids, causing heavy siltation; and ferruginous drainage from old mine works, causing siltation in an area receiving intermittent discharges of storm sewage. In the upper reaches, a few acid-tolerant invertebrate species survived in low numbers. Downstream recovery was not complete before the discharge of coal particles had occurred. In the reaches silted by ferric hydroxide or coal there was a pronounced reduction of 80-90% in faunal abundance. Clear differences were apparent in sensitivity of invertebrate groups to these types of siltation. (Baker-FRC)
W81-05970

**THE EFFECT OF MINERAL ADDITIVES IN FOOD ON BIOSYNTHETIC PROCESSES AND THE GROWTH OF CARP,**
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 8I.
W81-05973

**A SURVEY OF THE MACRO-INVERTEBRATE RIFFLE FAUNA OF THE RIVERS YSTWYTH AND RHEIDOL, WALES,**
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
M. P. Brooker, and D. L. Morris.
Freshwater Biology, Vol 10, No 5, p 459-474, October, 1980. 4 Fig, 4 Tab, 39 Ref.

Descriptors: *Fauna, *Riffles, Benthic fauna, Rivers, Shallow water, Turbulent flow, Ystwyth River, Rheidol river, *Wales, Catchment areas, Catchment basins, River basins, Watersheds, Heavy metals, Hydroelectric powerplants, *Macroinvertebrates, Population density.

Six surveys were undertaken of the macro-invertebrate fauna in March and September 1975 and July and September 1976 and 1977. Samples were collected at six sites in the Ystwyth catchment and seven sites in the Rheidol catchment in Wales. A total of 111 taxa was collected from the Ystwyth catchment. The Diptera and Plecoptera were generally the most frequently represented and, on individual survey dates, comprised up to 52% and 27%, respectively, of the total number of taxa at different sites. Throughout the catchment the fauna was dominated numerically by the Insecta, particularly Plecoptera, Ephemeroptera and Diptera and, except for Oligochaeta and Coleoptera, the representation of major groups was similar at sites with different concentrations of metals. Chloroperla spp. were the most abundant plecopterans. A total of 134 taxa was collected from the River Rheidol and some of its tributaries. Of these, 44 were exclusive to the Rheidol and 90 were common to the nearby Ystwyth catchment. Plecoptera were the most frequently represented, comprising up to 36 and 56% of the total taxa. There was no evidence that the distribution or relative abundance of the fauna of the catchments was directly related simply to heavy metal contamination. Average linkage clusters of Spearman rank correlation coefficients suggested that community affinities were probably related primarily to location within the catchment. There was no evidence in the Rheidol catchment that irregular discharges of water for hydroelectric puroses has any substantial effect on the invertebrate fauna, although total invertebrate density below the discharge was significantly higher than at an upstream site. (Baker-FRC)
W81-06003

**SYNERGISM, ANTAGONISM, AND ADDITIVITY OF PHENOL, PENTACHLOROPHENOL, AND DINITROPHENOL TO A FISH (NOTOPTERUS NOTOPTERUS),**
D.A.V. Coll., Muzaffarnagar (India). Pollution Relevant Research Lab.
S. R. Verma, S. Rani, and R. C. Dalela.
Archives of Environmental Contamination and Toxicology, Vol 10, No 3, p 365-370, 1981. 2 Tab, 15 Ref.

Descriptors: *Phenols, *Fish, *Toxicity, Chemical reactions, Chemical wastes, Chemical compounds, Water pollution effects, Pesticide toxicity, Phenolic pesticides.

Very little information is available on the interactions of drugs, heavy metals, and pesticides in fish, in spite of the fact that fish are frequently exposed to more than one toxicant in their environments and despite the availability of such data for mammals and insects. The toxicity to fish of pesticide mixtures and various other chemicals in combination may be additive, with each component keeping its individual toxicity; antagonistic, or less than additive; or synergistic, with the combination being more toxic than the sum of the toxicity of the individual components. This study investigated the toxicity of combinations of phenol (P), pentachlor-

ophenol (PCP), and dinitrophenol (DNP) to the fish Notopterus notopterus. The three compounds are among the most toxic and ubiquitous environmental contaminants in many industrial wastes. A total of 12 combinations of these chemicals produced toxicities to the fish ranging from antagonism to synergism. Nine of the combinations were synergistic, with the combination (P plus DNP)/PCP demonstrating the most synergistic effect. The effects were antagonistic with (PCP plus DNP)/P and (PCP plus P)/DNP combination and an additive effect was noted with the (DNP plus P)/PCP combination. All combinations of only two of the chemicals resulted in synergistic effects. It is concluded that different toxicants can interact with each other in the aquatic environment to produce synergistic, antagonistic, or additive effects. (Carroll-FRC)
W81-06010

**HEPATIC CARBOHYDRATE METABOLISM IN TILAPIA MOSSAMBICA (PETERS) ACCLIMATED TO LOW ENVIRONMENTAL PH,**
Sri Venkateswara Univ., Tirupati (India). Dept. of Zoology.
V. K. Murthy, P. Reddanna, and S. Govindappa.
Canadian Journal of Zoology, Vol 59, No 3, p 400-404, 1981. 2 Tab, 32 Ref.

Descriptors: *Fish, *Acidic water, Acidity, Chemical properties, Fallout, Air pollution, Adaptation, Acclimatization, *Hydrogen ion concentration, Lethal limit, Tilapia mossambica.

Freshwater fish, Tilapia mossambica, were exposed to various pH media and maintained at constant temperatures for 30 minutes. Percentage mortalities, mean survival times, and changes in oxygen consumption of fish at different media pH were noted. Changes were also noted in hepatic carbohydrate metabolism of fish acutely exposed and acclimated to sublethal acidic pH, 4.0. The lower lethal limit appeared to be pH 3.7 and the upper lethal limit 10.3. Sudden exposures of fish to acidic and alkaline media resulted in depleted whole-animal and weight-specific oxygen consumption. Gill mucification may have been responsible for oxygen consumption changes. Maximum oxygen depletion was noted immediately after exposure to the sublethal acidic pH, and the extent of suppression declines gradually with increasing days of exposure. Hepatic glycogen content was drastically depleted in response to a 1 day exposure to sublethal acidic pH. The pattern of hepatic tissue metabolism was found to be different in acclimated animals in that the tissue glycogen content was significantly higher than that of 1-day-exposed fish. It was concluded that acclimation of fish to a sublethal acidic pH medium was responsible for inducing compensatory mechanisms in hepatic tiddue which lead to depleted glycolysis and elevated gluconeogenesis, resulting in an increase in the glycogen content. (Baker-FRC)
W81-06013

**DISTRIBUTION OF AQUATIC OLIGOCHAETA IN THE FINNISH LAKE DISTRICT,**
Jyvaskylae Univ. (Finland). Dept. of Biology.
For primary bibliographic entry see Field 2H.
W81-06024

**MONITORING OF DDT, PCBS, AND OTHER ORGANOCHLORINE COMPOUNDS IN MARINE ORGANISMS FROM THE NORTH AEGEAN SEA,**
Thessaloniki Univ., Salonika (Greece). Dept. of Food Hygiene.
For primary bibliographic entry see Field 5A.
W81-06026

**TOXICOLOGICAL EFFECTS OF AERIAL APPLICATION OF MONOCROTOPHOS,**
CIBA-GEIGY of India Ltd., Bombay.
R. R. Rao, F. Quadros, R. M. Mazmudar, M. R. Marathe, and S. D. Gangoli.
Archives of Environmental Contamination and Toxicology, Vol 9, No 4, p 473-481. July, 1980. 4 Fig, 2 Tab, 13 Ref.

Descriptors: *Insecticides, *Monocrotophos, *Degradation, Agricultural chemicals, Toxicity, Water pollution effects.

The effects of aerial application of the insecticide Nuvacron 40 (monocrotophos) were determined in canal water and soil. The material was sprayed on cotton-growing fields, domestic animals, and humans at the rate of 400 ml on 9 liters per acre. In the canal water 0.15 ppm was present after 2 hours; all was completely degraded in 48 hours. Soil contamination was 0.49 ppm 2 hours after spraying, 0.43 ppm at 24 hours, 0.2 ppm at 48 hours, and 0.1 ppm at 7 days. (Cassar-FRC)
W81-06027

**INVESTIGATION ON THE CAUSE OF A FISH-KILL (EPINEPHELUS) IN THE KISAMOS GULF, CRETE,**
Thessaloniki Univ., Salonika (Greece). Dept. of Food Hygiene.
S. D. Kilikidis, A. P. Kamarianos, T. Kousouris, and I. Tsingkounakis.
Bulletin of Environmental Contamination and Toxicology, Vol 26, No 4, p 453-460, 1981. 2 Fig, 2 Tab, 22 Ref.

Descriptors: *Water pollution effects, Copper, *Fishkill, *Heavy metals, Crude oil, *Pesticides, Ammonia, Marine environment, Fish toxins, Plankton, Cyanide, Gulfs, Water analysis, Sea water.

The presence in the aquatic environment of chemical wastes such as heavy metals, pesticides, crude oil, phenolic compounds, chlorine derivatives and arsenicals may have deleterious effects on the behavior and health of fish. The causes of fishkills which occurred along the Gulf of Kisamos in northwestern Crete in July of 1979 were investigated. Many fish, mainly Epinephelus quaza, E. gigas, and E. alexandrinus, were washed ashore in a half-dead state. They exhibited upright circular swimming patterns, with their heads above water and their mouths open. Affected fish had hemorrhage and ecchymoses in the buccal cavity and gills, discoloration, frayed fins, ulcerations in the abdominal wall, and degeneration of the liver, heart and spleen. Seawater, plankton, and fish samples from different sites of the Gulf were analyzed for heavy metals and various other toxins, including organochlorine pesticides, nutrients, detergents and phenolic compounds. An area was identified which contained copper levels about ten times greater than those found in other sampling sites along the Gulf. High levels of ammonia and cyanide were also cited as possible causes of the large fishkills in the Gulf of Kisamos. The origin of these toxins was not confirmed. (Geiger-FRC)
W81-06031

## 5D. Waste Treatment Processes

**FEASIBILITY OF PHOTOCATALYTIC OXIDATION FOR WASTEWATER CLEAN-UP AND REUSE,**
SumX Corp., Austin, TX.
G. R. Peyton, and D. W. DeBerry.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108457, Price codes: A04 in paper copy, A01 in microfiche. Office of Water Research and Technology Report OWRT/RU-81/1, 1981. 44 p, 9 Fig, 5 Tab, 1 Append. OWRT-C-90152-R(No 9425)(1), 14-34-0001-9425.

Descriptors: *Wastewater treatment, *Oxidation, *Water reuse, *Solar radiation, Organic compounds, Wastewater oxidation, Catalysts, Costs, *Photooxidation.

A feasibility study has been conducted on a new treatment technology for the destruction of pollutant compounds in wastewater. The process uses solar energy to drive an oxidation which is photocatalyzed at the surface of a semiconductor powder. The process is being investigated particularly for water clean-up prior to industrial reuse, because of its non-energy-intensive nature. Five compounds (chloroform, dimethylamine, methanol, phenol, and ammonia) were used as model substrates, and removal at several pH values, using three different semiconductors (TiO2, ZnO, and Fe2O3) was investigated in the laboratory, using a xenon lamp to simulate solar radiation. While Fe2O3 was found to be ineffective, both ZnO and TiO2 catalyzed the removal of all compounds. Ammonia was not very effectively destroyed, but all four organic compounds experienced 30-50% removal in six hours at intensities slightly above that of normal solar radiation. Favorable cases were confirmed using sunlight. Quantum efficiencies for both sets of experiments were 13-20% for TiO2 and 4-7% using ZnO. Estimated treatment cost for a 1 mgd stream using laboratory conditions ranged from $0.18 - $0.72 per thousand gallons, depending on the values of engineering parameters which were not investigated in this feasibility study.
W81-05701

**WASTEWATER TREATMENT PLANTS INTO PHYSICAL-CHEMICAL PLANTS,**
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
S. A. Long, and F. E. White.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108465, Price codes: A07 in Paper copy, A01 in microfiche. Research Project Technical Completion Report, June, 1981. 126 p, 16 Fig, 17 Tab, 53 Ref. OWRT-A-036-PA(1), 14-34-0001-0140.

Descriptors: *Physicochemical treatment, *Biological wastewater treatment, *Wastewater facilities, *Parks, *Recreation facilities, *Cost analysis, Operating costs, Capital costs, Pilot plants, *Conversion, Load variations, Overdesign, Pennsylvania, Physical-chemical treatment.

Many parks and recreation areas have installed wastewater treatment plants using the extended aeration activated sludge process. Because of rxtreme load variations and periodic low flows, biological systems often do not treat these wastewaters sufficiently to meet current discharge requirements. As an alternative, the Physical-Chemical Treatment (PCT) process offers the advantage of on-off or variable rate operation with no apreciable loss in treatment quality. Pilot plant studies were run in order to confirm the potential use of the PCT process and to obtain information for design purposes. The use of either lime, or a combination of alum and polymer for coagulation, produced a pilot plant effluent suspended solids of less than 10 mg/l. The suspended solids were reduced to 3 to 5 mg/l by means of granular media filtration. Treatment with powdered activated carbon produced an effluent COD of approximately 30 mg/l while the use of granular activated carbon produced an effluent COD value of less than 1 mg/l. The capital cost for converting a biological wastewater treatment plant to PCT varies considerably with the type of equipment and design used as well as with the amount of original equipment reused. The projected capital cost is $45,460 for converting a 100,000 gpd conventional biological plant to a scheme including chemical coagulation, sedimentation, filtration, downflow granular activated carbon contact and a sludge storage tank. On an annual cost basis, the cnversion to a PCT plant is cost effective. (Eyerly-PA)
W81-05702

**BIODEGRADATION AND CARBON ADSORPTION OF CARCINOGENIC AND HAZARDOUS ORGANIC COMPOUNDS,**
IIT Research Inst., Chicago, IL.
E. G. Fochtman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-171852, Price codes: A03 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-032, March, 1981. 2 p, 2 Tab.

Descriptors: *Activated carbon, *Biodegradation, *Biological treatment, *Carcinogens, *Organic compounds, Water treatment, Hydrocarbons, Adsorption, Wastewater treatment.

The carbon adsorption isotherms and the ease of biodegradation were determined experimentally for 11 organic compounds selected from the EPA Priority Pollutant List and the OSHA List of Regulated Carcinogens to determine the capability of biological treatment and activated carbon adsorption to remove hazardous organic compounds from water and wastewater. All of the 11 compounds tested exhibited some degree of biological degradation. Carbon adsorption was also effective in removing the compounds from aqueous solution. The low solubility of most of the compounds, generally less than 1 ppm, made it difficult to prepare aqueous solutions free of undissolved chemical particles. In the procedure developed, water was pumped through a bed of beads coated with the chemical, then filtered to remove the particles of undissolved chemical. Analytical methods were adapted to analyze the very insoluble polynuclear aromatic hydrocarbons that tenaciously adsorbed on the glass surfaces of sample bottles and analytical glassware. (Moore-SRC)
W81-05756

**EPIDEMIOLOGICAL STUDY OF KLEBSIELLA PNEUMONIAE AMONG PULP AND PAPER MILL WORKERS,**
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5B.
W81-05763

**MUSKEGON COUNTY WASTEWATER MANAGEMENT SYSTEM, PROGRESS REPORT, 1968 THROUGH 1975,**
Muskegon County Board, MI. Dept. of Public Works.
Y. A. Demirjian, D. R. Kendrick, M. L. Smith, and T. R. Westman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-114613, Price codes: A18 in paper copy, A01 in microfiche. Environmental Protection Agency Repot EPA 905/2-80-004, February, 1980. 400 p, 89 Fig, 108 Tab, 15 Ref, 7 Append.

Descriptors: *Waste water management, *Waste water treatment, *Waste water irrigation, *Land disposal, Waste water disposal, Nutrients, Water quality control, Groundwater, Waste water renovation. Muskegon County, Michigan.

The Muskegon County Wastewater Management System is a lagoon-impoundment, spray irrigation treatment facility which serves 13 municipalities and five major industries. The system consists of a 4,455 hectare site which contains three aeration ponds, two storage lagoons of 344 hectares each and a total storage capacity of 19.3 million cubic meters, and 2,200 hectares of land irrigated by center-pivot irrigation rigs. The system is provided with a network of subsurface drains, open interception ditches and shallow wells to make possible the monitoring and control of the quality of water throughout the treatment process. With an average daily flow of 106 thousand cubic meters in 1975, the system provided discharge water of a quality consistently above NPDES specifications. Studies on water quality and soil-crop-nutrient balance revealte that by balancing the nutrients in wastewater with crop neds, more effective overall nutrient removal was achieved, simultaneously enhancing crop production and waste water renovation. Revenues from crop sales are returned to the system to ameliorate treatment costs which in 1975 amounted to less than $28 per thousand cubic meters ($106 per million gallons). Corn possesses several physiological attributes which make it a suitable crop for the heavy irrigation rates inherent to land treatment. Remarkably high corn yields have been achieved on predominantly sandy soils. After three years of operation, no significant changes have been found in the water quality parameters of the groundwater. During this same period, there appeared to be an improving trend in some indicator parameters in the surface water quality. (Moore-SRC)
W81-05765

**MUTAGENIC ACTIVITY AND CHEMICAL CHARACTERIZATION FOR THE PALO ALTO WASTEWATER RECLAMATION AND GROUNDWATER INJECTION FACILITY,**
Stanford Univ., CA. Dept. of Civil Engineering.
P. L. McCarty, J. Kissel, T. Everhart, R. C. Cooper, and C. Leong.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-117590, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S1-81-029, April, 1981. 2 p.

Descriptors: *Waste water renovation, *Waste water treatment, *Mutagens, *Municipal waste water, *Tertiary waste water treatment, Groundwater barriers, Chlorination, Fatty acids, Phthalates, Aromatic compounds, Brominated compounds, Chlorine dioxide, *Palo Alto, California.

At the Palo Alto Reclamation Plant 0.044 cu m/s (1 mgd) of secondary effluent is reclaimed through a series of waste water treatment processes including high lime treatment, aerator-fountain spraying, single-stage recarbonation, ozonation, mixed-media filtration, activated-carbon adsorption, final chlorination, and storage. A portion of the reclaimed water is injected into a series of wells to serve as a barrier against the intrusion of sea water from San Francisco Bay. Mutagenic activity (by the Ames test) was consistently found to be present in the secondary treated municipal waste water influent to the Reclamation Facility. This activity was not reduced significantly by high lime treatment, air stripping, recarbonation, or ozonation, even though these processes did remove a portion of the overall organic content of the waste waters and many of the volatile organic compounds. Activated-carbon adsorption was effective in removing mutagenic activity to such a degree that mutagenic activity could not be found in water used for injection or that taken from monitoring wells. Chlorination resulted in an increase in mutagenic activity. A laboratory study demonstrated that this increase in activity would not result if chlorine dioxide rather than chlorine was used for disinfection. The extracts used for mutagenic analyses contained a broad range of fatty acids, phthalates, aromatic compounds, and several unidentified bromine-containing compounds.
W81-05777

**CONTRACTOR'S ENGINEERING REPORT FOR THE DEVELOPMENT OF EFFLUENT LIMITATIONS GUIDELINES AND STANDARDS FOR THE PHARMACEUTICAL MANUFACTURING INDUSTRY POINT SOURCE CATEGORY,**
Burns and Roe Industrial Services Corp., Paramus, NJ.
Environmental Protection Agency Report EPA-440/1-80-084-a, June, 1980. 345 p, 14 Fig, 69 Tab, 110 Ref, 13 Append.

Descriptors: *Pharmaceutical industry, *Industrial wastes, *Waste water treatment, *Water pollution sources, Effluents, Pollutants, Heavy metals, Benzenes, Chlorinated hydrocarbons, Phenols, Cyanide, Biological waste water treatment, Suspended solids, Oxygen demand, Chemical treatment, Costs.

Under the regulation established for BPT control, the pharmaceutical manufacturing industry was grouped into five product or activity areas: fermentation products, biological and natural extraction products, chemical synthesis products, formulation products, and pharmaceutical research. In an industry survey, 115 of the 129 priority pollutants were identified in industry waste waters; thirteen were selected as being significant because of their dominant occurrence in the waste waters. They are phenol, benzene, chloroform, ethylbenzene, methylene chloride, toluene, chromium, copper, lead, merucry, nickel, zinc, and cyanide. Additional pollutants to be controlled are biochemical oxygen demand, total suspended solids, and chemical oxygen demand. These pollutants may be controlled by-in-plant or end-of-pipe treatment. Cyanide can be removed by chemical oxidation or thermal/pressure treatment; metals can be removed by reduction/precipitation and filtration; and organic chemicals can be removed by steam stripping. Biological treatment and filtration are the two main end-of-pipe treatments. The cost, energy and non-water quality aspects of the various treatment processes are presented. (Brambley-SRC)
W81-05779

**WASTEWATER TREATMENT WITH ULTRAVIOLET DISINFECTION AND INCREASED CAPACITY,**
Great Circle Associates, Walnut Creek, CA. (Assignee).
S. B. Mullerheim, and F. G. Williams.
U.S. Patent No 4,229,202, 15 p, 6 Fig, 20 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1091. October 21, 1980.

Descriptors: *Patents, *Wastewater treatment, *Separation techniques, Disinfection, Ultraviolet radiation, Ozone, Equipment, Filtration.

A method and an apparatus for treating wastewater such as sewage are disclosed. Designed principally for complete on-site wastewater treatment and disposal, the system separates wastewater into liquid wastes and solid wastes by filtration, treats the liquid wastes with ultraviolet radiation and disperses them into unsaturated ground. The solid wastes are periodically removed, along with used portions of the paper filter medium and delivered, in the case of sewage, to a composting area where the solids can be composted. A preferred embodiment includes the use of ultraviolet radiation having wavelengths effective both to destroy pathogens directly and to produce ozone from entrained air in the liquid filtrate, to react with pathogens to form stable compounds. An alternate embodiment of a wastewater delivery and filtration suction subsystem is disclosed, whereby filtration is made continuous and capacity is approximately doubled. (Sinha-OEIS)
W81-05781

**WET OXIDATION SYSTEM EMPLOYING PHASE SEPARATING REACTOR,**
Whirlpool Corp., Benton Harbor, MI. (Assignee).
R. B. Wheaton, and J. W. Van Kirk.
U.S. Patent No 4,229,296, 10 p, 3 Fig, 2 Tab, 8 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1117-1118. October 21, 1980.

Descriptors: *Patents, *Wastewater treatment, *Oxidation, Chemical oxygen demand, Equipment, Flow rate, *Organic wastes, Wet oxidation processes.

The invention relates to wet oxidation processes by which significant increases in reactor oxidation efficiency are possible through the use of single stage or multi-stage reaction zones where the gas phase (oxygen containing) is allowed to pass through at a flow rate independent of that associated with the liquid phase (waste water containing). Consequently, more oxygen can be supplied to a given volume of waste water than would be possible for a conventional reactors of equal size, so that at a given reactor time and temperature, higher COD removal for a given waste water is achievable. The increased wet oxidation efficiency is believed to be related to continuous removal of excess carbon dioxide from individual reaction zones. The reactor consists of a cylindrical pressure vessel mounted in a vertical position with ports at the top, bottom and side. Associated values and a water level sensor are utilized. The multi-stage oxidation system employs high pressure pumps, air compressors, heat exchangers, heaters, and two or more of the reactors connected to one another in series. Waste organic matter in water charged to the system at elevated temperatures and pressures in the presence of heated compressed air is oxidized to carbon dioxide and water progressively in each reactor stage. The end result is a greater removal of waste organic matter than can be achieved in a single stage reactor system. (Sinha-OEIS)
W81-05783

**WASTE TREATMENT APPARATUS WITH FLOATING PLATFORM,**
Clevepak Corp., White Plains, NY. (Assignee).
A. E. Molvar.

U.S. Patent No 4,229,302, 6 p, 2 Fig, 16 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1120. October 21, 1980.

Descriptors: *Patents, *Wastewater treatment, *Bodies of water, Aeration, Floating, Equipment, Lagoons.

An apparatus for treatment of waste water in a body such as a lagoon has a submerged aeration device suspended from a floating platform. Air is supplied to the aeration device by a conduit passing through the buoyant base of the platform to a central opening so that the conduit is an integral, structural part of the platform. (Sinha-OEIS)
W81-05784

**METHOD AND APPARATUS FOR RECOVERY OF HEAVY METAL IONS FROM DILUTE AQUEOUS SOLUTION,**
De luxe General, Inc., Los Angeles, CA. (Assignee).
D. J. Degenkolb, and F. J. Scobey.
U.S. Patent No 4,228,013, 10 p, 6 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 684-685. October 14, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, *Industrial wastes, *Separation techniques, Metals, Ion exchange, Absorption, Flow, Turbulence, Automatic controls, Reverse flow, Product recovery, Regeneration.

Heavy metal ions are recovered from a dilute aqueous solution by flowing the solution through either a single bed of ion-absorbing material in successive forward and reverse directions, or through a first bed of ion-absorbing material and then through a second bed of ion-absorbing material in the reverse direction of flow. The reversal of flow is to periodically mechanically agitate a bed of ion-absorbing material to dislodge contaminants. The method is accomplished by using one enclosed vessel, or a pair of enclosed vessels, that have valves to control the direction of flow. A timing device automatically reverses the direction of flow about each hour. After a relatively large number of reversals of flow the heavy metal ions are recovered from the ion-absorbing material and the same is regenerated in the process to again absorb ions from the water. The invention is used to recover silver from photographic processing or gold and uranium in mining processes. (Sinha-OEIS)
W81-05789

**DOMESTIC WATER SYSTEM,**
D. C. Hanna.
U.S. Patent No 4,228,006, 5 p, 2 Fig, 9 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 682. October 14, 1980.

Descriptors: *Patents, *Wastewater treatment, *Domestic wastes, *Water purification, Water reuse, Reclaimed water, Water conservation, Impaired water use, Equipment, Domestic water.

The specification discloses a domestic water system reclaiming waste water in which a tap water line supplies fresh water only to a kitchen sink and as a replenisher for a reclaim system supplying all the to a toilet, a lavatory, a bath tub, a clothes washer, laundry tubs and a dishwasher. Drains from the toilet and the kitchen sink lead directly to a sewer, and drains from all the other installations lead to a clarifier tank having an overflow to the sewer. A pump pumps water from the clarifier tank through filter tanks to all the installations except the kitchen sink and to a hot water heater supplying the lavatory, the bath tub, the clothes washer, the laundry tubs and the dishwasher. An inline instant hot water heater is positioned in the tap water line to a hot water tap of the kitchen sink. (Sinha-OEIS)
W81-05790

**MECHANICAL DEWATERING APPARATUS FOR ELASTOMER SLURRIES,**
E. I. DuPont de Nemours and Co., Wilmington, DE. (Assignee).
R. A. Covington, Jr., and O. M. Ekiner.
U.S. Patent No 4,228,005, 7 p, 7 Fig, 2 Tab, 5 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 681-682. October 14, 1980.

Descriptors: *Patents, *Wastewater treatment, *Industrial wastes, *Separation techniques, Polymers, *Dewatering, Salts, Equipment, Elastomers, Slurries.

The invention comprises a method and apparatus for separating a polymeric material from a mixture of the material in water. In accomplishing this separation, it has been discovered that efficient and continuous separation may be achieved by adding excess water under pressure to the polymer/water mixture in a separator. A method is provided for isolating an elastomer from a mixture of the elastomer and water containing up to about 90% by weight water by feeding the mixture into a thermally controlled, vertical separator containing a rotating screw. Simultaneously excess water is feed under pressure into the separator. Concentrated elastomer containing less than about 10% by weight total volatiles (including water) is withdrawn from the metering section of the separator and feed water and excess water is withdrawn from a water discharge port located near the upper end of the separator. (Sinha-OEIS)
W81-05791

**METHOD OF REMOVING PHOSPHATES FROM WASTE WATER,**
Takeda Chemical Industries, Ltd., Osaka (Japan). (Assignee).
Y. Makino.
U.S. Patent No 4,228,003, 5 p, 1 Fig, 7 Tab, 4 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 681. October 14, 1980.

Descriptors: *Patents, *Wastewater treatment, Water pollution treatment, *Separation techniques, Phosphates, Sea water, Coagulation, Hydrogen ion concentration, Fertilizers, Product recovery, *Phosphorus removal.

Removal of phosphates from waste water can be attained with improved efficiency and at low cost by admixing the waste water with seawater and adjusting the mixture to pH 9-11 to separate the sedimental phosphates. The sediment can be utilized as phosphatic fertilizer. (Sinha-OEIS)
W81-05792

**WASTE DISPOSAL TREATMENT OF CALCIUM-CONTAINING ORGANICALLY LOADED WASTEWATERS,**
Linde A.G., Weisbaden (Germany, F.R.). (Assignee).
H. Reimann.
U.S. Patent No 4,227,998, 3 p, 9 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 679. October 14, 1980.

Descriptors: *Patents, *Wastewater treatment, *Water pollution treatment, *Industrial wastes, Activated sludge, *Organic wastes, Aeration, Calcium, Chemical precipitation, Sugar manufacturing plants.

Wastewaters containing substantial BOD and substantial calcium ion concentrations, e.g., effluents from the washing and flushing cycles of sugar manufacturing plants, are activated by an activated sludge process under aeration with an O2-containing gas. The improvement comprises introducing a CO2-containing gas having a concentration of CO2 higher than that of air into liquid presented in the activated sludge system to precipitate calcium ion as calcium carbonate thereby lowering the pH of the liquid and facilitating the separation of the activated sludge solids and the bacterial action of the activated sludge process. (Sinha-OEIS)
W81-05794

**INDUSTRIAL WASTE INSPECTION PROCEDURE FOR A REGIONAL AUTHORITY,**
Massachusetts Metropolitan District Commission, Boston. Sewerage Div.
For primary bibliographic entry see Field 6E.
W81-05831

**WATER RE-USE PLAN ADVANCES IN NORTHGLENN,**
For primary bibliographic entry see Field 3C.
W81-05862

**TREATMENT OF REGENERANT WASTES FROM THE ION EXCHANGE PROCESS,**
M. C. Gottlieb, F. X. McGarvey, and F. X. Pollio.
Industrial Water Engineering, Vol. 18, No. 2, p 18-26, March-april, 1981. 11 Fig, 8 tab, 5 Ref.

Descriptors: *Ion exchange, *Regeneration, *Water treatment, Wastewater treatment, Water purification, Anion exchage, Cation exchange, Acids, Bases, Design criteria, Mexico.

Ion exchange regeneration wastes are often neutralized by combining the wastes from the anion and cation exchangers. The balance, and thus the quality of water discharged, depends on the raw water composition and the selection of the ion exchange process. Chemicals used in regeneration include NaCl, H2SO4, and HC1 (acidic cation exchangers) and NaOH, trimethylamine, and diethanolamine (basic anion exchangers). The combined regenerant contains these materials plus reaction products such as NaCl, silica, and CaSO4. Three different raw waters typical of mexico (total cation concentrations 100, 300, and 700 ppm, respectively) and processes designed for each are given as illustrations. (Cassar-FRC)
W81-05887

**CARBON SYSTEM SOLVES REFINERY WASTEWATER PROBLEM,**
Toa Oil Co., Kawaski (Japan).
T. Abe, T. Togashi, and Y. Nishiya.
Oil and Gas Journal, Vol. 79, No. 19, p 95-99, May, 1981. 7 Fig, 2 Tab.

Descriptors: *Activated carbon, *Oil wastes, *Oil industry, *Wastewater treatment, Organic compounds, Water pollution control, Backwash, Regeneration, Regulations.

The Toa Oil Company, Japan, refinery installed an activated carbon wastewater treatment system to remove oily wastes as required by Japan's atringent pollution control regulations. The entire carbon adsorption system occupies 372 sq meters of land, one-tenth the space needed for an activated sludge system. Because the wastestreams are expected to contain high concentrations of suspended solids and oil, engineers specified four fixed-bed adsorbers which could be backwashed. Two adsorbers contain 86 and 76 metric tons of carbon respectively. A third, with 16 metric tons, is designed for pulse-bed operation. air scouring and backwashing to remove accumulated oil and solids are done once every seven days. Reactivation, carried out twice since 1976, involves one hour'sresidence in a 950 degree C multiple hearth furnace. Effluent contains less than each of the following: 15 ppm suspended solids, 15 ppm COD, 5 ppm oil, and 0.5 ppm phenol. (Cassar - FRC)
W81-05888

**MONEY DOWN THE DRAIN: A RATIONAL APPROACH TO SEWAGE,**
Food and Energy Research Centre, Worcester (England).
P. J. Riley, and D. S. Warren.
Ecologist, Vol 10, No 10, p 342-345, December, 1980. 2 Tab, 3 Ref.

Descriptors: *Domestic wastes, *Municipal wastewater, *Wastewater treatment, Feces, Urine, Wastewater disposal, Sewage bacteria, Wastewater collection, Maintenance, Economic efficiency, Wastewater treatment facilities, Planning, *Great Britain.

Up-grading of current sewer systems in Great Britain is expected to cost several hundred million pounds sterling over the next few decades. Before this quantity of money is spent on rebuilding sewage collection and treatment facilities based essentially on the knowledge and technology of the middle of the 19th century, it is suggested that the whole problem of sewage management be ree-

valuated on the bases of modern knowledge in the fields of physics, chemistry, and microbiology. The main problems associated with human wastes are their oxygen demand, their microbiological contamination, and their mineral content. In order to meet the wastewater treatment goals of avoiding water pollution, preventing microbial contamination, and conserving plant nutrients, it would appear that keeping the flows of urine, feces, sullage (laundry and kitchen effluent), and industrial effluents separate and treating them separately would provide a more rational approach. Much of the technology for the separate treatment of waste components already exists. Wastewater management systems should consist of separation of urine and feces from other wastewaters in the home and collection systems based on regular collection of portable toilet tanks for central treatment. A separate treatment system for sullage would have to be established to complement this system. Industrial effluents should be treated individually by methods developed specifically for those wastes. These techniques for wastewater management can most easily be instituted in new and developing communities in rural areas and in the Third World. (Carroll-FRC)
W81-05892

**STUDENTS TACKLE WASTEWATER WOES,**
California State Water Resources Control Board, Sacramento.
C. May.
BioCycle, Vol 22, No 2, p 45-47, March-April, 1981. 2 Fig.

Descriptors: *Rural areas, *Water treatment facilities, Wastewater treatment, Aerated lagoons, Water quality, Sewage systems, Design criteria, Student participation, Universities, *California.

Six universities were invited to participate in a systems design competition for alternative methods of wastewater treatment for the rural town of Nipomo. From the start, each university approached the competition differently. The competing teams each received a copy of a facility plan that had been rejected and the environmental impact report on the existing system which was failing rapidly, plus over 2,500 pages of technical information on unconventional on-site and alternative rural wastewater systems. Three of the universities considered the total wastewater system design in their programs. Two others excluded evaluation of the collection system. Only one evaluated an on-site system. The theme common to each proposal was limited collection of wastewater with emphasis on on-site and cluster treatment facilities. The on-site wastewater management districts proposed by all three winning universities may be the only acceptable solution to the needs of many unsewered rural areas. (Baker-FRC)
W81-05894

**DEGRADATION TREATMENT OF WASTE WATER FROM OLIVE PROCESSING,**
Bari Univ. (Italy). Ist. di Chimica Fisica.
M. Della Monica, A. Agostiano, D. Potenz, E. Righetti, and M. Volpicella.
Water, Air, and Soil Pollution, Vol 13, No 2, p 251-256, June, 1980. 3 Fig, 2 Tab, 2 Ref.

Descriptors: *Food-processing wastes, *Wastewater treatment, Industrial wastes, Food processing industry, *Olive processing, Biological oxygen demand, Oxygen demand, Sedimentation, Land disposal.

The possibility of a complete treatment of waste water from olive processing has been examined. Residual water from such processing has very high values of COD and BOD, averaging about 100,000 and 40,000 ppm, respectively. The method studied consists of waste water being poured onto agricultural soil contained in watertight tanks where biological transformations of the organic loading can take place. Water to be treated was periodically poured onto these in a maximum soil to water volume ratio of 1/3. The bacterial flora produced profound biological changes in a relatively short time. Most of the organic substances are rapidly assimilated so that the C/N ratio in the soil reaches optimal values. Since they cannot filter into the underlying soil, inorganic compounds, particularly potassium, reach critical values after the addition of an amount of water equal to the volume of soil treated. It is felt that soil subjected to multi-year processing could be used as soil-compost with high content of both organic and inorganic assimilable substances. The process involves sedimentation of waste water, removal of the whole oil content, and treatment of water on agricultural soil. The whole process operates at a very low cost due to the fact that it can be rendered completely automatic. The labor expense needed to periodically empty the container and refill it with fresh soil is compensated for with the sale of the final soil-compost product. (Baker-FRC)
W81-05931

**TREATMENT OF THE EFFLUENT OF A GLUCOSE PRODUCTION PLANT USING A ROTATING BIOLOGICAL PACKED BED,**
Tehran Univ. (Iran).
S. M. Borghei.
Process Biochemistry, Vol 16, No 2, p 29, 30, 32-34, February-March, 1981. 8 Fig, 4 Tab, 13 Ref.

Descriptors: *Food processing wastes, *Starch, *Glucose, *Rotating biological packed bed, *Wastewater treatment, Industrial wastewater, Biological wastewater treatment, Biological oxygen demand.

A rotating biological packed bed was used to treat high volume, high strength wastes from a Tehran, Iran, plant manufacturing starch and glucose from wheat. The pilot-scale apparatus consisted of 3 cylindrical baskets packed with polypropylene rings. The baskets were rotated partially submerged in a 16.1 liter wastewater tank. BOD reduction averaged 90% and total organic carbon reduction, 85%, at loading rates up to five kg BOD per cu meter per day and a retention time of five hours. Efficiency of BOD removal was 72% and total organic carbon, 68%, at a loading rate of 9.5 kg BOD per cu meter and 2.7 hours residence time. Increasing the rotational speed from 3.4 rpm to 7.6 rpm did not produce the anticipated improvement in performance except at the highest flow rate. Most of the removal occurred in the first stage. The sludge produced had good settling properties; the effluent from loadings of 5-6 kg BOD per cu meter per day was nonodorous and well-oxidized. At higher loadings, the effluent was colloidal and needed further treatment before disposal. Nitrogen removal was poor, less than 25%. (Cassar-FRC)
W81-05936

**STUDY FAVORS OXYGEN BLEACHING OVER BIOLOGICAL TREATMENT PLANT,**
For primary bibliographic entry see Field 3E.
W81-05938

**DISTRIBUTION OF BACTERIA IN A CONTINUOUS-FLOW NITRIFICATION COLUMN,**
Queen Elizabeth Coll., London (England). Dept. of Microbiology.
D. J. Cox, M. J. Bazin, and K. Gull.
Soil Biology and Biochemistry, Vol 12, No 3, p 241-246, 1980. 3 Fig, 24 Ref.

Descriptors: *Trickling filters, *Nitrification, Wastewater treatment, Filters, Nutrients, Nitrates, Nitrites, Biological treatment, Nitrogen fixing bacteria, Bacteria, Ammonia, Bacterial analysis, Biological filters.

Often, studies of microbial interactions under natural conditions are difficult to interpret due to environmental variables such as rainfall, temperature changes and diurnal rhythms. Laboratory experiments were conducted to determine whether nitrification in glass bead columns most closely resembled the diffusion-dependent process in trickling filters or conditions assumed to occur in soil. The growth of nitrifying bacteria on glass beads from a nitrification column was examined with a scanning electron microscope. Ammonium sulfate solutions were supplied at a constant rate to Nitrosomonas europaea and Nitrobacter agilis growing on the beads. Incomplete conversion of ammonium ion to nitrate and nitrite occurred, showing that bacterial growth was not nutrient limited. After seven months, nitrifying bacteria were found only in the upper regions of the column in predominantly monolayer formations. Glass beads further down the column were covered mostly by slime. These findings suggest that growth of the nitrifiers was independent of diffusion of metabolites through a microbial film as well as of competition among the bacteria for growth space on the surface of the beads. (Geiger-FRC)
W81-05941

**WATER-BASED FLEXOGRAPHIC INKS--REGULATED CHEMICAL SUBSTANCES,**
Huber (J. N.) Corp., Edison, NJ.
G. A. Lessells.
Tappi, Vol 63, No 10, p 57-59, October, 1980.

Descriptors: *Ink wastes, *Pigments, *Waste treatment, Industrial wastes, Heavy metals, Metals, Organic compounds, Toxicity, *Waste disposal.

Wastes from water-based flexograph inks used in box making must be treated before discharge, according to requirements of the Clean Water Act and the Resource Conservation and Recovery Act. The most widewpread treatment method is chemical coagulation or flocculation of the ink ingredients and settling or filtration of the solids. A newer method concentrates untreated ink wastes by evaporation of volatile components. Biological treatment is applicable only if a plant has an existing sewage disposal plant for starch wastes; a toxic sludge can be produced. Some possible components of flexo inks or their waste treatment products are: lead, chromium, barium, diarylide pigments, 3,3'-dichlorobenzidine, 3,3'-cichlorobiphenyl, phthalocyanine blue and green, alcohols, and glycol ethers. (Cassar-FRC)
W81-05961

**ALGAL ASSAY BOTTLE TEST RESPONSE TO PULP AND PAPER MILL EFFLUENTS,**
Institute of Paper Chemistry, Appleton, WI. Environmental Sciences Div.
M. G. Tesmer, and T. W. Joyce.
Tappi, Vol 63, No 9, p 105-108, September, 1980. 3 Fig, 3 Tab, 7 Ref.

Descriptors: *Pulp and paper industry, *Waste water treatment, Effluents, Industrial wastes, Nitrogen, Nutrients, Phosphorus, Algae, Bioassay, Toxicity.

The Algal Assay Bottle Test (AA:BT) of the Environmental Protection Agency was evaluated using pulp and paper whole-mill effluents. Untreated and biotreated effluents were examined. Significant interference from biotic and abiotic particulates was noted at high effluent concentrations, i.e., concentrations above 32%. Particulate interference was not controlled by autoclaving and centrifuging test effluents. Such treatment resulted in an altered test effluent. When high effluent concentrations are expected, the AA:BT is not generally recommended. The AA:BT did provide acceptable information on effluent nutrient availability, and when modified slightly, allowed identification of the primary limiting nutrient. Low effluent concentrations exposed to defined synthetic nutrient media demonstrated minimal particulate interference. Comparisons between the predicted yields and measured yields provided estimates of effluent nutrient availability and identified the limiting nutrient. The AA:BT is recommended for nutrient characterization of pulp and paper effluents when concentrations are low, not exceeding 16%. (Baker-FRC)
W81-05962

**PHENOL OXIDATION WITH HYDROGEN PEROXIDE,**
Interox Chemicals Ltd., Widnes (England).
A. F. E. Sims.
Effluent and Water Treatment Journal, Vol 21, No 3, p 109-112, March, 1981. 2 Fig, 3 Tab, 6 Ref.

Descriptors: *Phenols, *Oxidation, *Hydrogen peroxide, *Chemical wastewater, *Wastewater

treatment, Industrial wastewater, Iron, Steel industry, Solvents.

Phenolic effluents in wastewater from coking, oil refining, chemical and steel manufacture, and other industrial activities were treated by hydrogen peroxide oxidation as a cheaper alternative than biological oxidation, tankering away for disposal, or other chemical treatment. Optimum conditions for phenol oxidation with hydrogen peroxide were a 3:1 H2O2:phenol molar ratio, initial pH of 4, and 10 mg per liter iron catalyst. Using these conditions as a starting point, the process was modified to treat three effluents: nitrosophenol effluent from a pharmaceutical manufacturer, a complex mixture of phenol and other chemicals from electrotinning of steel, and a paint stripping effluent containing 4,000 mg per liter phenol with a COD of 25,000 mg per liter. (Cassar-FRC)
W81-05997

**THE BEHAVIOR OF POLYCHLORINATED BIPHENYLS AND ORGANOCHLORINE INSECTICIDES IN PRIMARY MECHANICAL WASTEWATER TREATMENT,**
Imperial coll. of Science and Technology, London (England). Public Health Engineering Lab.
A. E. McIntyre, R. Perry, and J. N. Lester.
Environmental Pollution, (Series B), Vol 2, No 3, p 223-233, 1981. 6 Tab, 24 Ref.

Descriptors: *Wastewater treatment, *Polychlorinated biphenyls, *Organic pesticides, Agricultural chemicals, Insecticides, Primary wastewater treatment, Aroclors, Land disposal, Sludge, Chemical composition.

Analyses were made of samples obtained during the monitoring program conducted at the New Works Extension to Oxford Sewage Treatment Works. Results of the analyses indicated that the primary sedimentation process used at the plant removes about one half of the PCB and dieldrin and more than one third of the DDE from the raw sewage. Concentrations of PCB and organochlorine insecticides (OCL) in the primary sludges were in the microgram per liter range. These results compare favorably with findings of a survey in Canada of 33 sewage treatment works. The results of this and similar studies have demonstrated that substantial concentrations of PCB and OCL into primary sludges will occur in the primary sedimentation process of sewage treatment. The method of disposal of sludges, whether to agricultural land, in landfills, or at sea, may result in the introduction of these persistent organic materials into food chains, where biomagnification may occur. (Baker-FRC)
W81-06004

**CZ UPGRADES POWER GENERATION, POLLUTION CONTROL AT ELK FALLS,**
P. Hanson.
Canadian Pulp and Paper Industry, Vol 34, No 1, p 98, 100, January, 1981.

Descriptors: *Pulp and paper industry, *Water pollution control, Overflow channels, Spillways, Combined sewer overflows, Channels, Kraft mills, *Pulp wastes, Mills.

At a pulp and paper mill on Vancouver Island a major 5-yr upgrading of power generation and pollution control systems has been underway. The project was begun because of particulate emissions from the lime plant causing complaints from local residents. In another area, the kraft mill, spills would result in stock passing into the sewers and out into Discovery Passage. To overcome this problem a system was installed that would use the trenches in the mill, and when a spill occurred, direct the stock to a holding tank, later returning it to processing. Similarly, overflowing clarifiers, mud washers and storage tanks would flow into the sewer of the recaust area and on to the mill outfalls. These sewers were subsequently isolated and run into a collection chamber. The liquid is pumped from this chamber to a redundant green-liquor clarifier. The mud removed from the underflow of the clarifier is put back into the process via the mud washer. Clarified outflow is pumped back to the recaust area to be used in wash-up hoses and process. Improvements to fight air pollution from this same plant are also described. (Baker-FRC)
W81-06014

**ODOUR PROBLEMS AND SOLUTIONS,**
Mather and Platt Anti-Pollution Systems, Ltd., Burgess Hill (England).
R. Anderson.
Effluent and Water Treatment Journal, Vol 21, No 3, p 122-123, 126-127, March, 1981. 10 Ref.

Descriptors: *Odor control, *Sulfur compounds, Sewer gas, *Wastewater treatment, Sewer systems, Sulfides, Activated carbon, Adsorption, Ozonation, Oxidation, Absorption, Neutralization, Organic compounds.

Odors are regulated in the United Kingdom by several sections of the Public Health Act. Unpleasant odors may arise from sewerage, sewage treatment and disposal, and various industries. Some of the offending compounds, which have very low threshold of smell values, associated with sewage treatment are hydrogen sulfide, methyl mercaptans, methyl sulfides, amines, indole, skatole, fatty acids, alcohols, and ketones. Odors may be prevented or minimized by maintaining aerobic conditions in the sewer system, confining the malodorous air in a building, operating processes to prevent escapes of odors from equipment, and good housekeeping. Some odor control means are high stacks, masking agents, ozonation, thermal and catalytic oxidation, adsorption with activated carbon or alumina, absorption systems, neutralizing compounds, and hypochlorite treatment. Odor treatment must be designed for each individual problem. (Cassar-FRC)
W81-06016

## 5E. Ultimate Disposal Of Wastes

**DISTRIBUTION OF AQUIFERS, LIQUID-WASTE IMPOUNDMENTS, AND MUNICIPAL WATER-SUPPLY SOURCES, MASSACHUSETTS,**
Geological Survey, Boston, MA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W81-05712

**HYDROGEOLOGY, ESTIMATED IMPACT, AND REGIONAL WELL MONITORING OF EFFECTS OF SUBSURFACE WASTEWATER INJECTION, TAMPA BAY AREA, FLORIDA,**
Geological Survey, Tallahassee, FL. Water Resources Div.
J. J. Hickey.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-221384, Price codes: A03 in paper copy, A01 in microfiche.
Geological Survey Water-Resources Investigations 80-118, 1981. 40 p, 20 Fig, 1 Tab, 34 Ref.

Descriptors: *Monitoring, *Injection wells, Water pollution effects, *Waste water disposal, Water quality, Geohydrology, Aquifer characteristics, Groundwater movement, Water level fluctuations, Saline-freshwater interfaces, Underground storage, Model studies, *Florida, Tampa Bay area, Impaired water use, Irrigation, Golf courses.

Six proposed injection sites are located in Pinellas County, Fla., and the city of St. Petersburg. Projected maximum injection rate, if all sites become operational, will be about 40 million gallons per day. The injection zone at the proposed sites is in a consistently dolomitized section of the Avon Park Limestone in the lower part of the Floridan aquifer. The injection zone contains saline ground water that has a chloride concentration of 19,000 to 20,000 milligrams per liter. Pressure and velocity changes were computed at selected regional locations in the upper and lower parts of the Floridan aquifer. Results of the model computations suggest that the regional impact after 20 years of injection will be small. Three locations are proposed for regional monitoring of subsurface injection. They are in the vicinity of the intersection of highways U.S. 19 and U.S. 60 in Pinellas County, Sun City in Hillsborough County, and the intersection of Sheldon Road and Gunn Highway in Hillsborough County. (USGS)
W81-05729

**WATER-LEVEL DATA FOR WELLS IN AND NEAR BURIAL GROUND 4, OAK RIDGE NATIONAL LABORATORY, TENNESSEE, 1975-1979,**
Geological Survey, Knoxville, TN. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05734

**PRODUCTION OF NON-FOOD-CHAIN CROPS WITH SEWAGE SLUDGE,**
PEER Consultants, Inc., Rockville, MD.
L. A. Abron-Robinson, C. Lue-Hing, E. J. Martin, and D. W. Lake.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-125296, Price codes: A06 in paper copy, A01 in microfiche.
Environmental Protection Agency Project Summary EPA-600/S2-80-199, March, 1981. 3 p, 1 Tab.

Descriptors: *Sludge disposal, *Land disposal, *Crop production, *Cost analysis, Fertilizers, Cotton, Trees, Sod, Nutrients, Application rates, Injection, Surface irrigation, Municipal wastes, *Impaired water use.

This study investigated the feasibility of using sewage sludge in cultivating three non-food-chain crops currently sold on the open market or with good potential for marketability. A cost analysis determined how cultivation costs using sewage sludge compared with costs using commercial fertilizer. Cotton, sod, and energy biomass trees were determined to have the best potential for cultivation using sewage sludge, based on the market values and nutrient requirements for each crop and on the hectares presently under cultivation for production of these crops. Application modes were injection, surface irrigation, and truck spreading. Results indicate that large quantities of sewage sludge can be used, based solely on the nitrogen and phosphorus requirements for the cultivation of these crops. Injection was the most expensive mode of application, and truck spreading the least. Although the total costs for fertilization using commercial fertilizer are less than the costs for using sewage sludge, the latter would be viewed more favorably if the municipality generating the sludge bore the costs. (Brambly-SRC)
W81-05759

**HELMINTH AND HEAVY METALS TRANSMISSION FROM ANAEROBICALLY DIGESTED SEWAGE SLUDGE,**
Illinois Univ. at Urbana-Champaign.
P. R. Fitzgerald.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-161846, Price codes: A04 in paper copy, A01 in microfiche.
Environmental Protection Agency Project Summary EPA-600/S2-81-024, March, 1981. 4 p, 2 Tab.

Descriptors: *Nematodes, *Heavy metals, *Digested sludge, *Infection, Accumulation, Cadmium, Organic compounds, Municipal wastes, Pathology, Soil treatment, Public health, *Sludge disposal.

This summary discusses the findings of a study designed to determine the transmission to an animal host of the ova of the nematode worm Ascaris sp. that have survived through a modern sewage treatment process and are present in the sludge. Four large experiments and three smaller ones involving 178 specific pathogen-free pigs were used. Natural transmission of Ascaris sp. from soil treated with liquid anaerobically digested sewage sludge that had been stored for several years occurred in a few pigs in each of four experiments. Also, natural transmission from Nu-Earth, a dried, stored sewage sludge, also occurred in pigs that were exposed to this material by contact in the pens. In general, ova in anaerobically digested sludge or in Nu-Earth remained unem-

bryonated until after they were exposed to the air. Within 6 weeks after exposure to air, the ova began to embryonate, and thereafter, a small percentage of the ova that embryonated became infective for pigs. The occurrence of heavy metals in the tissues of swine held in pens treated with anaerobically digested sludge or Nu-Earth, which originated from a large municipality, was also studied. Chemical analyses of kidneys, livers, hearts, diaphragm muscles, and bones were conducted to determine the quantities of the heavy metals cadmium, zinc, copper, iron, lead, chromium, and nickel that were present in the tissues following exposure of the pigs to different amounts of the sewage products in or on the soil. Only cadmium accumulated to a significant degree in some tissues of swine exposed to sludge containing heavy metals. No physiological or pathological changes associated with exposure to the sludge material were detected. Examination of visceral fat from control and experimental pigs indicated that there was no unusual accumulation of organic compounds including polychlorinated biphenyls and the insecticides Heptachlor and Dieldrin.
W81-05760

**THE IMPACT OF A HIGH LEVEL NUCLEAR WASTE REPOSITORY ON THE REGIONAL GROUND WATER FLOW,**
Analytic and Computational Research, Inc., Los Angeles, CA.
For primary bibliographic entry see Field 5B.
W81-05841

**PATHOGEN SURVIVAL IN LIME-STABILIZED SLUDGE,**
Environmental Surveillance Lab., Davis, CA.
D. R. Storm, B. Kelly, G. Gannon, and E. Meyer.
BioCycle, Vol 22, No 2, p 48, 50-51, March/April, 1981. 1 Tab, 6 Ref.

Descriptors: *Sludge, *Pathogens, Lime, Monitoring, Land disposal, Agriculture, Landfills, Sanitary landfills, Sludge drying.

Field tests were conducted to monitor the biological quality of a static pile of lime-stabilized sludge over a priod of several months. Test results indicated that the microbiological hazards of lime-stabilized sludge may decrease significantly with the passage of time, although the overall quality may still limit its use in agriculture. This study suggests that even though the numbers of viable Ascaris suum ova in the sludge may be greatly decreased, many of these organisms survive the hostile environment and are still viable after 60-120 days. Thus, whether or not the lime-stabilized sludge can be reclaimed for agriculture depends on the initial quality of the sludge produced at the Vallejo treatment facilities and how it is handled and incorporated into the soil. If initial concentrations of pathogenic organisms are low to nil, land spreading probably can be accomplished without endangering public health. Continuous microbiological monitoring of the sludge would provide the needed data base to assess public health risks over a representative time period. (Baker-FRC)
W81-05872

**WATER-BASED FLEXOBRAPHIC INKS--REGULATED CHEMICAL SUBSTANCES,**
Huber (J. N.) Corp., Edison, NJ.
For primary bibliographic entry see Field 5D.
W81-05961

**COSTS OF MAINTAINING PUBLIC HEALTH STANDARDS FOR SPRAY IRRIGATION OF MUNICIPAL WASTE WATER SYSTEMS,**
Economics Research Service, Washington, DC. Natural Resource Economics Div.
For primary bibliographic entry see Field 6C.
W81-05964

## 5F. Water Treatment and Quality Alteration

**PRELIMINARY INVESTIGATION OF A SHALLOW GROUND-WATER FLOW SYSTEM ASSOCIATED WITH CONNETQUOT BROOK, LONG ISLAND, NEW YORK,**
Geological Survey, Syosset, NY. Water Resources Div.
K. R. Prince.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-228751, Price codes: A03 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-47, November, 1980. 37 p, 11 Fig, 3 Tab, 10 Ref.

Descriptors: *Groundwater, *Flow system, *Streamflow, *Surface-groundwater relations, *Data collections, Groundwater movement, Seepage, Gaging stations, Observation wells, Monitoring, Networks, Water table, Water level fluctuation, New York, *Long Island, Connetquot Brook.

Under natural conditions, about 95 percent of the flow in Long Island streams is derived from ground-water seepage. The ground-water system that feeds the streams is a shallow subsystem that overlies the regional subsurface flow system. The Connetquot Brook basin was selected for study because it has not been appreciably affected by urbanization. Studies in the basin indicate that the shallow ground-water flow system circulates to a depth of less than 30 feet below the stream channel. Directly beneath the stream, shallow groundwater flow is upward toward the stream channel, but elsewhere in the basin it is predominantly horizontal. Relatively large increases in head with depth in the first 3 feet below the streambed suggest local differences in hydraulic conductivity or in size of area through which the water flows, or both. Water-table contour maps of the area adjacent to Connetquot River for September 1977 and March 1978 indicate that the shape of the water table and the direction of flow lines change seasonally. Variations in ground-water levels and gradients directly affect the rates of ground-water seepage to the stream. (USGS)
W81-05727

**BIODEGRADATION AND CARBON ADSORPTION OF CARCINOGENIC AND HAZARDOUS ORGANIC COMPOUNDS,**
IIT Research Inst., Chicago, IL.
For primary bibliographic entry see Field 5D.
W81-05756

**EVALUATION OF POWDERED ACTIVATED CARBON FOR REMOVAL OF TRACE ORGANICS AT NEW ORLEANS, LOUISIANA,**
New Orleans Sewerage and Water Board, LA.
M. A. Epton, and J. F. Becnel.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-161853, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-027, March, 1981. 3 p, 2 Tab.

Descriptors: *Water treatment, *Drinking water, *Organic compounds, *Activated carbon, Chlorination, Trihalomethanes, Water pollution.

Several organic contaminants were found in New Orleans' finished drinking water. A bench-scale research program designed to determine the effectiveness of powdered activated carbon (PAC) for removing these organic contaminants was conducted at the Carrollton Purification Plant. Additional studies attempted to evaluate the effects of changing the point of chlorine addition within the normal treatment scheme and to correlate nonspecific analytical parameters with specific organics. To select one PAC for further investigations, four commercially available PAC's were studied. At dosages of 5, 50, and 500 mg/l, the PAC added to coagulated settled water yielded average respective removals of 2%, 21%, and 65% of the trihalomethane formation potential. Even at the 500 mg/l dosage, only one of four tested PAC's was able to reduce the formation potential to a level below the maximum contaminant level of 0.10 mg/l in finished drinking water. The PAC's did not reduce the levels of the high molecular weight organic contaminants studied. Full-scale plant profiles demonstrated that conventional treatment alone affected a removal of 46% of the trihalomethane formation potential. Therefore, only the addition of 500 mg/l PAC effected more removal than conventional treatment. (Moore-SRC)
W81-05764

**REMOVAL OF NITRATE FROM CONTAMINATED WATER SUPPLIES FOR PUBLIC USE,**
Boyle Engineering Corp., Bakersfield, CA.
G. A. Guter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-163206, Price codes: A06 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-029, April, 1981. 3 p.

Descriptors: *Water treatment, *Potable water, *Nitrates, *Contamination, *Ion exchange, Resins, Reverse osmosis, Selectivity, Capital costs, Operating costs, Water quality standards, Regeneration, Wastes, *Nitrate removal.

The general applicability of three treatment processes for removal of nitrate from public water supplies are evaluated: reverse osmosis (RO), ion exchange, and the combination of RO followed by ion exchange. The evaluation consists of using laboratory size and field-test equipment to establish design criteria and operating experience useful for designing a full-scale plant of approximately 1 mgd capacity. Ion exchange column tests were conducted with five strong-base anion exchange resins on nitrate-laden water of various anion compositions. From this work, estimates of product water quality and the bed volume capacity for feedwater of any composition can be made. Also, a working hypothesis was developed from an analysis of the data about how the chemical structure of resins can be practically altered to obtain nitrate selectivity. A 20-inch diameter pilot anion exchange column containing 4.36 cu. feet of resin, was designed and operated for over 1 year. Data from this column operation are used to verify estimates of pilot column performance and to project the cost for equipment and regenerant for a well site installation to treat up to 1 mgd. Because of the interim nature of this report, only preliminary data are reported on the operation of a 20,000-gpd RO system. The well waters used contained 16-23 mg/l nitrate-nitrogen and over 300 mg/l sulfate. Based on reducing nitrate to 14 mg/l and sulfate to 200 mg/l, the capital costs were estimated to be less than $90,000 for 500,000 gpd. Sodium chloride costs for regenerating the resin range from 1.9-10 cents/1000 gal depending on the well and level of treatment. Significant amounts of waste water rich in sodium, sulfate, nitrate, and chloride would be produced in the regeneration phase. (Brambley-SRC)
W81-05769

**INTERRELATIONSHIP OF BACTERIAL COUNTS WITH OTHER FINISHED WATER QUALITY PARAMETERS WITHIN DISTRIBUTION SYSTEMS,**
Salem and Beverly Water Supply Board, Beverly, MA.
J. K. Reilly, and J. S. Kippin.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-168726, Price codes: A04 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-035, March, 1981. 4 p, 4 Tab.

Descriptors: *Water quality, *Water treatment, *Bacteria, *Coliforms, Water distribution, Residual chlorine, Ecosystems, Conveyance structures, Water chemistry, Beverly, Salem, Massachusetts.

This study's objective was to obtain realistic information concerning the interrelationships among temperature, chlorine, turbidity, coliforms, and Standard Plate Count (SPC) densities present in finished water after treatment and distribution in Beverly and Salem, Massachusetts. Bacterial identifications were performed to determine types and densities of isolates from the SPC and coliform tests. The frequency of coliform isolation was independent of free chlorine, turbidity, and tempera-

ture. SPC's were not contingent on low level turbidity and varied with respect to free chlorine residual and temperature. SPC's exhibited no interrelationship with coliform counts when the SPC was less than 50 organisms/ml. A slight inverse relationship was noted between free chlorine residual and turbidity. Of the physical and chemical parameters measured, free chlorine residual had the greatest influence on the microbial population. Encapsulated Klebsiella pneumonise, Enterobacter agglomerans, Enterobacter aerogenes and Enterobacter cloacae, which gave typical coliform results, exhibited the ability to survive a free chlorine residual of 0.2 mg/l or more. The diversity of organisms (39 bacteria and a yeast) identified by the SPC method strongly sugests the phenomenon of an established microbial ecosystem within the distribution networks. (Author's abstract)
W81-05780

**WATER TREATMENT APPARATUS WITH MEANS FOR AUTOMATIC DISINFECTION THEREOF,**
F. A. Hoeschler.
U.S. Patent No 4,228,000, 11 p, 6 Fig, 7 Ref; Official Gazette of the United States Patent Office, Vol 999, No 2, p 680. October 14, 1980.

Descriptors: *Patents, *Water treatment, *Water quality control, Disinfection, Water purification, Bacteria, Equipment, Regeneration, Water softeners.

A water treatment device of the type which automatically regenerates itself of predetermined intervals is provided with a special disinfectant feeder device which dispenses a predetermined amount of disinfectant into the water treating media bed and the device itself to kill the bacteria preventing the media and the apparatus from becoming a bacterial breeding ground. Since the disinfectant solution is completely purged from the water treatment media and the apparatus during the regenerating cycle, no residual type of disinfection is possible, and thus, nothing is added to the water supply. Further since the apparatus does not require that the water supply system be opened to accomplish the disinfection and/or media rejuvenation, the system is kept closed at all times and this eliminates the possibility of airborne bacteria or other contaminants from being introduced into the system. (Sinha-OEIS)
W81-05793

**FACTORS AFFECTING COUNTERFLOW ION EXCHANGE EFFLUENT QUALITY,**
W. S. Miller, and M. B. Yeligar.
Industrial Water Engineering, Vol 18, No 2, p 27-33, March-April, 1981. 11 Fig, 4 Tab, 3 Ref.

Descriptors: *Ion exchange, *Regeneration, *Countercurrent flow, Water purification, Cation exchange, Anion exchange, *Water treatment, Water quality, Demineralization.

Both equipment parameters and operational/process parameters affect the quality of counterflow ion exchange effluents. These factors were studied in a 48 inch diameter pilot unit using upflow regeneration with a water block flow technique. For best results the operation must have a well-compacted bed, proper distribution of regenerant, high quality water for regenerant make-up and rinses, termination of the service cycle based on predetermined volume throughput, and deep beds. It is cheaper to use lower chemical dosages of fresh regenerant than to install a regenerant reclaim system. Water quality is also superior in the former case. The quality of demineralized water produced by the counterflow system cannot be equated solely to the sodium leakage or the cation unit. There are several factors that affect final effluent quality, including sodium throw from the anion unit, which may vary with resin type, age, and regeneration procedure. Examples of ion exchange processes are given in 3 industries--paper, electronics, and refining. (Cassar-FRC)
W81-05827

**FACTORS INFLUENCING HOUSEHOLD WATER LEAD: A BRITISH NATIONAL SURVEY,**
Royal Free Hospital School of Medicine, London (England). Dept. of Clinical Epidemiology and Social Medicine.
For primary bibliographic entry see Field 5A.
W81-05876

**PHYSICAL WAYS TO CONTROL BUILD-UP OF 'RUST' IN WELLS,**
Regina Univ. (Saskatchewan). Dept. of Microbiology.
R. Cullimore.
Johnson Driller's Journal, Vol. 53, No. 1, p 8-9, 23,25, 1981.

Descriptors: *Corrosion control, *Wells, *Iron bacteria, *Cleaning, Cathodes, Oxidation-reduction potential, chemical precipitation, Iron, Manganese, Ultraviolet radiation, Ultrasonics, Iron oxide, Slime, Heated water, Injection wells, Steam, Bacteria.

Five systems for unplugging wells clogged with iron bacterial slime were investigated: ultraviolet light, ultrasonics, elevation of well water temperature to pasterization range, changing the redox potential of the water, and cathodic protection. Ultraviolet light was ineffective under turbid conditions and against slime. Iron bacterial slurries subjected to ultrasonics in a tissue dismembranator were not disintegrated by the usual 1 min treatment nor by a 45 min treatment. Pasteurization at 54 degrees C killed all 28 strains of iron bacteria tested. This method offers many advantages (no harmful chemicals, kills bacteria in the adjoining aquifer) and may be implemented by recycling water through a water heater or direct injection of hot water or steam. altering the redox potential by excluding oxygen from the well prevents both bacterial growth and chemical reaction. This may be achieved by vacuum sealing the well or by sealing off the screen section of the well using an anoxic block. TheVY-REDOX system, developed in Denmark, injects oxygenated water into the aquifer, causing iron bacterial growth and precipitation of iron and manganese away from the well. Cathodic protection with the anode in the well and the screen as the cathode produced heavy growth around the anode and water high in rusty particles. (Cassar - FRC)
W81-05886

**TREATMENT OF REGENERANT WASTES FROM THE ION EXCHANGE PROCESS,**
For primary bibliographic entry see Field 5D.
W81-05887

**THE CONCEPT OF AUTOMATIC SYSTEMS IN THE TREATMENT AND DISTRIBUTION OF DRINKING WATER,**
Societe Lyonnaise des Eaus et de l'Eclairage (France).
P. Alla, and B. Guirkinger.
Aqua, No. 1, p 46-50, 1981. 6 Fig, 5 Ref.

Descriptors: *Automation, *Waste treatment facilities, *Municipal water, Drinking water, Water delivery, Water distribution, Computers, Water quality control, Management planning, Project planning, *Water supply systems.

Fundamental constraints in the design of automatic systems for water treatment include the need for product water to meet precise quality standards and the need to provide consumers with an adequate quantity of water at all times. Automatic systems for water treatment comprise several links involving sensors, the central unit, actuators, and connections or linkages between these items. Sensors which are both reliable and rugged are needed to provide dependable information for the system. The central unit, which determines actions to be taken on the basis of supplied data, may be very simple or highly sophisticated; a computer may be used to classify parameters, apply mathematical laws and statistics, and control numerous devices. The actuators perform the actions which the central unit commands. the acutators must be equipped with sensors to assure that commands are performed. The linkages must provide for reliable transfer of information. The automatic system should provide for efficient operation of each stage of treatment and optimization of the system as a whole. The operator of the plant should be consulted throughout the design process to assure that the atuomated system meets the desired objectives. In addition, the automated design should permit direct and manual control of the actuators in the case of failure of the central unit. The plant's equipment should be designed for very rapid repair, and preventive maintenance should be practiced conscientiously. Operating staff shouldbe trained to use the system comfortably, snce acceptance by the staff is the key to the success of the atuomated system. (Carroll-FRC)
W81-05889

**O3 + CL2 PRODUCES TASTE-FREE, NO THM, SAFE PIPED PRODUCT,**
Jordan (Edward C) Co., Inc., Portland, ME.
B. E. Soule, and S. J. Medlar.
Water and Sewage Works, Vol 127, No 3, p 44-45, March, 1980. 2 Fig.

Descriptors: *Ozonation, *Chlorination, *Water treatment, *Sherbrooke, Quebec, Canada, Purification, Disinfection, Lake Memphremagog, Chlorine.

At the Sherbrooke, Quebec water treatment plant, ozonation and chlorination are used to treat drinking water. Preozonation eliminates chloroform formation during the treatment process and minimizes the potential for taste and odor problems. Postozonation provides disinfection. Chlorine added to the water leaving the plant carries a residual through the system. The city of Sherbrooke has a population of about 110,000 served by the water treatment plant. The water supply includes the 64 square mile Lake Memphremagog about 18 miles west of the city, a 30 MGD water treatment plant, and an extensive water-distribution system including two in-town water-storage reservoirs and six booster-pump stations. Micrstraining is the first treatment step. During the summer months when there is considerable algae activity, the water is prechlorinated at a pump station. After microstraining, the water passes through two pairs of ozone contact chambers containing submerged diffusers. Next the water passes through to a 24 MG concrete clearwell, from which it is pumped to the city's distribution system. To ensure the integrity of the finished water, a dose of 1.5 mg/L chlorine is injected directly into the transmission main as the water is pumped into the distribution system. (Baker-FRC)
W81-05929

**ADSORPTION OF TRIHALOMETHANES BY GRANULAR ACTIVATED CARBON: A BENCH SCALE STUDY OF THE ADSORPTION ISOTHERMS IN BINARY AND MULTICOMPONENT AQUEOUS SOLUTIONS,**
Howard Univ., Washington, DC. Dept. of Civil Engineering.
M. R. Siddique, M. M. Varma, K. T. Doty, and A. Machis.
Aqua, No 7, p 157-161, 1980. 4 Fig, 2 Tab, 9 Ref.

Descriptors: *Trihalomethanes, *Activated carbon, *Adsorption, Chloroform, Bromoform, Organic compounds, *Water treatment, Chlorinated hydrocarbons, Design criteria, Water purification.

Adsorption isotherms for individual trihalomethanes (THM) in aqueous solution and granular activated carbon were of the Freundlich type. The activated carbon had the highest adsorptive capacity for bromodichloromethane (CCHBrCl2), followed by bromoform (CHBr3), chloroform (CHCl3), and chlorodibromomethane (CHBr2Cl). A multicomponent system containing all four THMs produced an adsorption isotherm significantly different from the one calculated using the individual isotherms. In addition, the dissociation coefficients for CHCl3 in the multicomponent system were computed and plotted as a function of the initial concentration of CHCl3 in the solution.

The resulting curve was very different from a similar plot for the binary system, showing the strong influence of the other THMs on the separation process. Optimum removal occurred at about 100 micrograms per liter, with decreases in efficiency at higher concentrations. Plotting total THM in a similar way produced no consistent relationships. This study demonstrates the difficulties of developing design data for removing THM from water in treatment processes. (Cassar-FRC)
W81-05946

**ELECTRON-MICROSCOPIC STUDY ON ORGANIC COLOUR IN WATER,**
Yamanashi Univ., Kofu (Japan). Dept. of Environmental Engineering.
T. Ishibashi.
Aqua, No 1, p 3-5, 1980. 10 Fig.

Descriptors: *Color removal, *Flocculation, *Coagulation, *Electron microscopy, Alum, Clay, *Water treatment, Colloids, Microscopy, Humic acids, Hydrogen ion concentration.

Organic color, produced by brewed tea, was examined at magnifications of 10,000 and 30,000 by electron microscope photography. The raw water used in the experiments had a pH of 7.5, alkalinity of 24 mg per liter, and 15 color units. It simulated natural color in water containing humic substances. Variables were pH (7.5 and 4.5) and coagulant (alum and clay). Photos revealed the following: (1) color alone, pH 7.5--ellipsoid particles 0.05-0.07 micrometers with a few small agglomerates, (2) color alone, pH 4.5--more agglomeration, flocs 1-2 micrometers, (3) color plus clay (40 turbidity units) and pH 7.5--color particles adsorbed onto clay particle surfaces, (4) color plus 1.0 mg per liter alum, pH 7.5--no remaining discrete color particles, rapid flocculation, (5) color plus 0.2 mg per liter alum, pH 4.5--larger flocs formed, (6) color, 40 turbidity units of clay, and 0.5-1.0 mg per liter alum--color particles adsorbed onto clay surfaces and all incorporated into aluminum hydroxide gel. (Cassar-FRC)
W81-05947

**CAPITAL COST OF RURAL WATER DISTRIBUTION SYSTEMS,**
Ohio State Univ., Columbus. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6C.
W81-05957

**THE MECHANISM OF DISSOLVED AIR FLOTATION FOR POTABLE WATER: BASIC ANALYSIS AND A PROPOSAL,**
Imperial Coll. of Science and Technology, London (England). Dept. of Mineral Resources Engineering.
J. A. Kitchener, and R. J. Gochin.
Water Research, Vol 15, No 5, p 585-590, 1981. 1 Fig, 12 Ref.

Descriptors: *Water treatment, *Flocculation, *Drinking water, Dissolved air flotation.

An alternative is suggested to the present dissolved air flotation (DAF) process for clarifying river or reservoir water which should be more economical for waters of low solids content. A simple estimate suggests that, for most potable waters, the present consumption of supersaturated water is highly inefficient; the buoyancy theoretically available is vastly in excess of that required to raise the solids. The suggested procedure is based on mixing bubble-free supersaturated water with chemically treated water, followed by conditioning in a flocculator under moderate shear. Under these conditions bubbles grow from nuclei within the flocs, which can subsequently be floated in a quiescent tank. Bench tests indicate that the method is feasible, the growth time of the bubbles being comparable with that needed for good flocculation. (Baker-FRC)
W81-05958

**BIOLOGICAL AND PHYSICO-CHEMICAL TREATMENT PATTERN (IN FRENCH),**
A. Tiret, and J. Sibony.
Aqua, No 7, p 11-14, 16. 1980. 6 Fig.

Descriptors: *Activated carbon, *Biological treatment, *Ozonation, *Water treatment, Aerobic conditions, Annet-sur-Marne, *Paris, Drinking water, Filter media.

The third phase in the development of the Annet-sur-Marne Waterworks, Paris, produces 20,000 cu meters per day of drinking water without chlorination. It uses preozonation and a high performance fluidized micro-sand filter clarifier. Aerated granular activated carbon beds (BIOCARBONE process) promote biological coagulation, thus reducing the need for chemical treatment. All processes are computer-controlled. (Cassar-FRC)
W81-06029

**NEW WATER TREATMENT PACKAGE AT MERY-SUR-OISE, IN THE VICINITY OF PARIS, A STORAGE RESERVOIR (LA NOUVELLE FILIERE DE TRAITEMENT DE L'EAU POTABLE A MERY-SUR-OISE, PRES DE PARIS: LE BASSIN DE STORAGE),**
Compagnie Generale des Eaux, Paris (France).
For primary bibliographic entry see Field 2H.
W81-06030

**CONSERVATION OF WATER WITH REFERENCE TO THE INTERNATIONAL WATER SUPPLY AND SANITATION DECADE,**
National Environmental Engineering Research Inst., Nagpur (India).
For primary bibliographic entry see Field 3D.
W81-06039

**DEVELOPMENT OF SIMPLE AND ECONOMIC FILTRATION METHODS FOR RURAL WATER SUPPLIES,**
Maharashtra Engineering Research Inst., Nasik (India). Environmental Engineering Research Div.
J. N. Kardile.
Aqua, No 1, p 226-229, 1981. 6 Fig, 2 Tab.

Descriptors: *Rural areas, *Water supply, *Filtration, Economic aspects, *Water treatment facilities, *India, Filter media, Turbidity.

There is a need for the development of simple and economic filtration methods for use in rural water treatment facilities with small capacities. The slow sand filters recommended for village water supplies are often inadequate for the treatment of turbid raw water sources, and pretreatment for the sand filters is expensive. Three innovative water treatment plants constructed in India are discussed. The Ramtek plant, constructed in 1973, is comprised of two separate units, each of which includes one gravel bed prefilter chamber followed by one dual media filter bed. The dual media filter bed consists of a top coarse coconut shell media followed by a fine sand media. The Varangaon plant, constructed in 1977, is comprised of two pretreatment units operated in parallel, each of which consists of one gravel bed flocculator and one tube settling tank, which are followed by three dual media filter beds. The dual medial filter beds again are coconut shell, followed by fine sand. The Chandori plant, constructed in 1979-1980, includes one gravel bed flocculator-cum-tube settler unit followed by one dual media filter bed, also using coconut shell and sand. In all cases the source water had a high turbidity, which was reduced to levels below 1.0 turbidity unit by the treatment processes. Each of the plants was constructed with gravity masonry side walls, with roofs only on the control rooms. All other units were open to the sky. The designs used are adaptable, with some modifications, for fabrication of package plants. The plants can be built with local materials and labor, and the absence of mechanical equipment and the compact plant designs allows simple maintenance. In addition, construction costs for the three plants were between 30 and 50 percent lower than costs for conventional plants of the same capacity. (Carroll-FRC)
W81-06044

**EXPERIENCE IN THE REMOTE CONTROL AND AUTOMATION OF WATER SUPPLIES IN SWITZERLAND (SITUATION ET UTILISATION DES APPAREILS DE COMMANDE A DISTANCE EN SUISSE),**
Zurich Service des Eaux (Switzerland).
M. Schalekamp.
Aqua, No 1, p 235-240, 1981. 29 Fig.

Descriptors: *Water supply, *Automation, *Metropolitan water management, Remote control, *Switzerland, Computers, Drinking water, Water treatment, *Water supply systems.

Water supply systems in Switzerland have used remote control and automation for over 50 years. Of the 120 spring water works, 45 percent need no control, and the remaining 55 percent are connected to a control center. Ninety percent of the lake water and groundwater works are fully automatic, and the other ten percent will be shortly. The towns of St. Gallen and Zurich use ultramodern remote control systems. The water treatment plant in St. Gallen is fully automatic and requires no personnel. The Zurich plant employs an operational staff which works with such modern auxiliary equipment as displays and high speed copiers. Operational experience with remote control systems has demonstrated that user software generally turns out to be more expensive than expected. Personnel working with software should have experience with process control computers and a thorough understanding of the subject. The only way to ensure that software costs are not exceeded and that the plant operates smoothly and optimally is to employ technically qualified staff. (Carroll-FRC)
W81-06045

**CONTROL AND REGULATION OF LONDON'S WATER SUPPLY,**
Thames Water Authority, London (England). Metropolitan Water Div.
L. O. Wild.
Aqua, No 1, p 230-234, 1981. 8 Fig.

Descriptors: *Metropolitan water management, *Water supply development, *Water control, *London, Great Britain, Economic aspects, Political aspects, Water conveyance, Conveyance structures, Water treatment facilities, History, Water supply systems.

An overview of the history and current condition of water abstraction, storage, treatment, and delivery systems in the London metropolitan area in Great Britain is presented. The water supply system, developed over a period of about 400 years, now delivers an average of 400 million gallons per day to serve 5.9 million inhabitants. The first municipal pumping activities were initiated in 1582, followed by construction of a water conveyance canal in 1613. In 1904, the eight private water companies serving the London metropolitan area were absorbed into the Metropolitan Water Board. The water supply system includes 122 covered reservoirs, 10,000 miles of tunnels and pipes, 121 pumping stations, and more than a dozen treatment facilities of various sizes. In many cases, water treatment plants and fittings designed as much as 100 years ago have been retained in spite of poor locations or the availability of more efficient equipment simply because replacement costs are so high. Often new machinery is installed in an old facility even though a new site would be more efficient. A new technique of high speed, low cost, soft ground mining permits cost-effective installment of new tunneling in the clay soil under London, providing more flexibility in the acquisition of new sites for treatment works and permitting the elimination of some small and inefficient works. Projected shifts to centralized remote control of the tunnel system will also improve the efficiency of the supply system. (Carroll-FRC)
W81-06046

**DESIGN OF WATER TREATMENT PLANTS IN DEVELOPING COUNTRIES,**
Montgomery (James M.) Pasadena, CA.
S. Kawamura.
Aqua, No 1, p 223-225, 1981. 1 Fig.

Descriptors: *Developing countries, *Water treatment facilities, *Design criteria, Economic aspects,

Water treatment, Filtration, Flocculation, Sedimentation, Chemical treatment, Flow measurement, Mixing.

Since the technological conditions in developing countries generally differ from those in industrialized countries, engineers familiar with local conditions should appraise new water treatment technologies and modify and develop new technology to meet the needs of the particular situation. Major factors affecting the design of water treatment plant facilities in developing countries include the availability of capital, of skilled and unskilled labor, of major equipment items, of construction materials, and of water treatment chemicals. Although conventional treatment, direct filtration, or in-line filtration can each be selected for use in water treatment plants, depending on the quality of the raw water source, conventional treatment is recommended for use in developing countries because of its fail-safe nature. Conventional treatment includes the following unit processes: plant flow measurement, coagulant feeding, flash mixing, flocculation, sedimentation, filtration, and disinfection. Factors which should be considered in designing each of these unit processes for treatment plants in developing countries are identified, and recommendations regarding the design of each of these processes are presented. (Carroll-FRC)
W81-06047

**RENEWABLE ENERGY SOURCES AND WATER TREATMENT,**
Technische Hogeschool, Eindhoven (Netherlands). Dept. of Physics.
H. Beurskens, and C. D. Ouwens.
Aqua, No 1, p 218-222, 1981. 3 Tab, 20 Ref.

Descriptors: *Energy sources, *Water treatment, Solar energy, Wind, Organic matter, Hydroelectric power, *Water supply development, Developing countries, Economic aspects.

The use of renewable energy sources within the context of low cost technology for water supply and water treatment is becoming increasingly attractive, particularly in developing countries. Problems associated with the use of fossil fuels and nuclear energy include environmental problems, exhaustion of supplies, dependence on countries rich in needed raw materials, rising costs, and the complexity and vulnerability of the energy infrastructure. Potential renewable energy sources which could be harnessed for water supply and water treatment applications include solar energy, wind energy, such organic materials as wood and wastes, hydropower, and radiation cooling. Energy is needed for nearly all processes in the field of water supply and water treatment, including pumping of water, desalination, disinfection, and hot water supply. The application of wind energy systems in the Cape Verdian Islands is used to demonstrate the potential for large-scale use of a renewable source of energy. Wind energy systems there are used for pumping water, generation of electricity, desalination of seawater and brackish groundwater, and small cooling plants. Advantages of renewable energy sources include the absence of problems associated with the use of fossil and nuclear energy, possession of some form of renewable energy source by most countries, generally lower costs, suitability for decentralized applications in remote areas, and easy adaptation to local circumstances and applications. The choice of an alternative energy system for a given situation is complicated by the large number of potential renewable energy sources, conversion systems, and energy forms, and by the fact that many systems are still in developmental stages. (Carroll-FRC)
W81-06048

**A CONTROL CENTRE FOR COMMUNAL GAS AND WATER SUPPLY NETWORKS,**
B. T. Painter.
Aqua, No 1, p 57-58, 60, 1981. 6 Fig.

Descriptors: *Telemetry, *Computers, *Water supply, Remote control, Automation, Distribution, Water conveyance, Bochum, *Germany, *Water supply systems.

The Stadtwerke Bochum GmbH is responsible for the supply of gas, water, electricity, and district heating to the domestic and industrial consumers of the town of Bochum, Germany. A common control and supervisory center based on modern telemetry equipment has been developed for the gas and water supply networks. Microprocessor modules operating autonomously from the conventional master station are used to facilitate interfacing between the computer and the several types of telemetry systems. In order to minimize the number of engineers needed, planning of the combined control center for the gas and water supply networks was accomplished in several phases, beginning with telemetry to monitor the gas supply network and followed by telemetry to monitor the water supply network. Telemetry to measure gas pressure at the district reducer stations and extensive remote control of important facilities was then implemented. Finally, a process computer for data reduction and analysis was installed. The computer performs continuous control, sequence control, and data display and logging activities. Forty-eight telemetry stations transmit data from the gas and water networks. Gas and water input and output quantities are reported hourly by the system. System data needed for planning purposes is stored and printed automatically. This system provides network operators with flexible information processing capabilities that ensure increased understanding of events within the supply networks. Future extensions of the system can be integrated without reliance on computer specialists. (Carroll-FRC)
W81-06049

## 5G. Water Quality Control

**INTEGRATED CONTROL OF COMBINED SEWER REGULATORS USING WEATHER RADAR,**
American Society of Civil Engineers, New York. Urban Water Resources Research Council.
M. B. McPherson.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-175804, Price codes: A05 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S2-81-041, April, 1981. 3 p.

Descriptors: *Combined sewers, *Urban runoff, *Storm runoff, *Weather forecasting, *Radar, Rainfall, Flow regulators, Prediction, Water storage, Flow rates, Flood forecasting, Combined sewer overflow.

The possibility of reducing the extent of overflows from combined sewer systems was studied, so that extensive and costly storage, transport and treatment facility requirements would be reduced. In general, when no in-line or other in-system storage is used, integrated regulator operation has no advantage over local automatic-dynamic regulator control unless expected flow-rates to the interceptors are estimated before they occur, and an operational bias is introduced that either minimizes overflows from only some of the regulators on an interceptor or favors the timing of overflows from all of the outlets, such as after the initial storm period. A review of the capabilities of digital recording weather radar indicates it has the best poential for estimating rainfall needed for flowrate predictions. Other possible uses for such radars in metropolitan areas were considered, particularly their use as part of urban flood warning systems. The possibility of inducing in-line storage in collector sewers to gain greater flexibility with integrated regulator operation was also considered. While initial improvements are expected to be highly system specific, increasing implementation will produce information on wider application of integrated control methods. (Brambley-SRC)
W81-05771

**MEADOWLAND NATURAL TREATMENT PROCESSES IN THE LAKE TAHOE BASIN: A FIELD INVESTIGATION,**
Nevada Univ., Las Vegas. Dept. of Biological Sciences.
F. A. Morris, M. K. Morris, T. S. Michaud, and L. R. Williams.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-185639, Price codes: A09 in paper copy, A01 in microfiche. Environmental Protection Agency Project Summary EPA-600/S4-81-026, April, 1981. 5 p, 2 Fig.

Descriptors: *Lake Tahoe, *Water pollution control, *Storm runoff, *Urban runoff, *Sediment control, Filtration, Nutrient removal, Water chemistry, Laminar flow, Pollution load, Ponding, Water pollution sources.

An area planning agency for Lake Tahoe suggested that natural treatment processes in stream environment zones could be used to control nutrients and sediment flowing toward the lake. The purpose of the study was to measure the amount of constituents filtered from runoff water by natural processes; the study was a survey of existing conditions only, and no attempt was made to alter those conditions. Samples were collected from seven tributary systems and five nearshore locations in the lakes in the South Lake Tahoe area and analyzed to determine nutrient and sediment load before, during, and after storm episodes, and during seasonal weather changes. The water parameters measured were: nitrogen; phosphorus; carbon nutrients; chlorophyll a; fecal coliforms; pH; alkalinity; conductivity; residue; dissolved oxygen; and turbidity. All sheet-flow systems demonstrated filtration of pollutants and sediments to some extent; however, variables such as beaver dams and livestock grazing together with storm episodes yielded inconsistent results. It was concluded that sheet flow can be an effective way of treating runoff waters, and that ponding of runoff waters can also reduce chemical and sediment loads. Roadways contribute high levels of nitrogen, and volcanic cinder, used as a road abrasive in the winter, adds high levels of phosphorus to the runoff waters. (Brambley-SRC)
W81-05774

**HYDROXYPROPYLENE-AMINO-PHOSPHONIC-SULFONIC ACIDS FOR INHIBITING SCALE FORMATION,**
Petrolite Corp., St. Louis, MO. (Assignee).
D. Redmore, and F. T. Welge.
U.S. Patent No 4,229,294, 9 p, 9 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1117. October 21, 1980.

Descriptors: *Patents, *Water quality control, *Scaling, Water softening, Industrial water, Chelation, Chemical reactions, *Corrosion control, Water supply systems.

The use of compounds for inhibiting scale formation is described. The compounds are characterized by the presence of N-methyl, or substituted methyl, phosphonic acid and N-hydroxy-propylenesulfonic acid groups. These compounds contains at least one or more of each group and are bonded to the same or different amino groups. They are derived by reacting an amine with both (1) an epihalohydrin-bisulfite addition product and (2) with a carbonyl compound, such as formaldehyde, and phosphorous acid or its equivalent. They have a wide variety of uses, for example as scale and corrosion inhibitors, iron oxide removers, chelating agents, etc. (Sinha-OEIS)
W81-05782

**WATER QUALITY CONTROLS ON IMPERIAL VALLEY DRAINAGE,**
Colorado River Board of California, Los Angeles.
V. E. Valentine.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No 2, p 233-237, June, 1981. 2 Tab.

Descriptors: *Groundwater, *Irrigation, *Agricultural wastes, *Pumps, *Water quality control, Runoff, Flow, Salinity, Rainfall, Dilution, Flooding, Agricultural hydrology, Nitrogen, *Imperial Valley, California.

The Imperial Irrigation District of California is described, and impacts of water quality controls there are considered. Irrigation has been practiced

since 1901. Currently, the District delivers water to over 500,000 acres. The water diverted by the District has high electroconductivity and total dissolved solids levels, but has a low nutrient and pesticide content. Continuation of the productive use of lands in this district is dependent on the removal drainage of the salts brought into the valley in the irrigation water. Because of the valley's location in a closed basin below sea level, its drainage cannot be discharged into the ocean. It is stored in the Salton Sea. Imposition of water quality controls on the Salton Sea would defeat the primary storage function of the Sea. (Titus-FRC)
W81-05801

**MICROBIAL DEGRADATION OF AROMATICS AND SATURATES IN PRUDHOE BAY CRUDE OIL AS DETERMINED BY GLASS CAPILLRY GAS CHROMATOGRAPHY,**
Alberta Univ., Edmonton. Dept. of Microbiology.
P. M. Fedorak, and D. W. S. Westlake.
Canadian Journal of Microbiology, Vol 27, No 4, p 432-443, April, 1981. 9 Fig, 4 Tab, 23 Ref.

Descriptors: *Fate of pollutants, *Microbial degradation, *Oil pollution, Marine environment, Aromatic compounds, Hydrocarbons, Crude oil, Nutrients, Nitrogen, Phosphates, Water pollution.

Water samples from a commercial harbor, a pristine marine area, and an oil tanker dock area, all in Washington state, were spiked with Prodhoe Bay crude oil to study the microbial degradation of saturates and aromatics. Replicate cultures were established in shakeable flasks with and without nitrogen and phosphate supplements for various incubation periods. At the end of the experiment, the residual oil was separated on silica gel columns into saturate and aromatic fractions, which were analyzed by gas chromatography. Both fractions were extensively degraded by microorganisms after 27 days when nitrogen and phosphorus were added. Without nutrient supplementation, the aromatics were degraded more rapidly in the samples from the commercial harbor area and from the pristine environment, while samples taken near oil tanker docks showed moderate degradation of both fractions. Simple aromatics were degraded more readily than n-alkanes in time course studies, and the broken down saturates were removed quickly. Degradation progressed from lower molcular weight, less complex molecules to larger, more complex molecules. (Geiger-FRC)
W81-05877

**EPA RESEARCH IN URBAN STORMWATER POLLUTION CONTROL,**
Municipal Environmental Research Lab., Edison, NJ. Storm and Combined Sewer Section.
R. Fields.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY5, p 819-835, May, 1980. 1 Fig, 2 Tab, 60 Ref.

Descriptors: *Water pollution control, Government supports, Storm runoff, Water, Government finance, Financial aspects, Costs, Urban runoff, *Combined sewer overflows.

A program was originated in 1964 to quantify urban storm and combined sewer overflow pollution problems and develop countermeasure controls. Federal expenditures in the neighborhood of $1 million have brought about the creation of an advanced technology to handle these problems. There have been over 150 projects under the program. These are discussed under the general headings of problem definition, user assistance tools (instrumentation and computers), land management, collection system control, storage, treatment, sludge and solids, integrated systems, and technical assistance and technology transfer. Under problem definition, past characterization studies for storm flow provided a data base for pollutant source accumulation and hydraulic and quality loads. Proper instrumentation was developed for storm flow measurement, which is essential for process planning, design, control, evaluation, and enforcement. Land management studies included all measures for reducing urban and construction site stormwater runoff and pollutants before they enter the downstream drainage system. Treatment studies included physical/chemical treatment, biological treatment, disinfection, and analyses of treatment process performance. (Baker-FRC)
W81-05901

**PRACTICAL APPLICATION OF A GROUND WATER MODEL,**
Geotechnical Inst. (Denmark).
J. Baumann, H. K. Hansen, O. Hansen, and T. Sorensen.
Aqua, No 1, p 62-65, 1981. 7 Fig.

Descriptors: *Groundwater pollution, *Groundwater management, *Simulation analysis, Mathematical studies, Groundwater movement, Water pollution control, Denmark, Frederikssund, Hydrologic models, Geohydrologic units, Phenols, Iron, Sulfates.

The water supply of the town of Frederikssund, Denmark, was threatened by iron and sulfate pollution from postglacial peat and mud deposits near the well field and by percolation into the groundwater of phenol derived from tar waste buried at some distance from the source. A groundwater model which used computer-based simulation was developed to test the effects of various preventive measures which would address both of these problems. The area covered by the groundwater model was subdivided into rectangular cells, and a continuity equation describing water transport to and from neighboring cells, infiltration, and removal of water by pumping was developed for each cell. In order to prevent further pollution from the postglacial peat and mud deposits, the groundwater level in the valley reservoir needed to be raised. The phenol pollution problem, on the other hand, required that the flow of groundwater be directed away from the borings threatened by this hazard. Analysis of the problem using the model indicated that moving a large part of the pumping activity from the river valley to a plateau area to the north of the current well field area would elevate the water level in the valley reservoir and result in rotation in the direction of flow of phenol-polluted groundwater away from the water supply area and towards the fjord. The model used in this study is applicable to situations in which the polluting materials are dissolved in the groundwater and move together with it. (Carroll-FRC)
W81-05950

**ADSORPTION, DESORPTION, SOIL MOBILITY AND AQUEOUS PERSISTENCE OF FENSULFOTHION AND ITS SULFIDE AND SULFONE METABOLITES,**
Department of Agriculture, London (Ontario). Research Inst.
For primary bibliographic entry see Field 5B.
W81-05963

**RIVER BASIN MANAGEMENT BY ECONOMIC INCENTIVES OR REGULATORY SANCTIONS--NATIONAL EXPERIENCES: ENGLAND,**
Severn-Trent Water Authority, Birmingham (United Kingdom).
For primary bibliographic entry see Field 6F.
W81-05977

**RIVER BASIN MANAGEMENT BY ECONOMIC INCENTIVES OR REGULATORY SANCTIONS--THE GENERAL SITUATION IN SWEDEN, ILLUSTRATED BY THE GOTA RIVER CASE,**
Goteborg Regional Sewerage Co. (Sweden).
For primary bibliographic entry see Field 6F.
W81-05978

**CANADA-U.S. WATER MANAGEMENT: NEW PROGRAMS FOR NEW CHALLENGES,**
Inalnd Waters Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 6D.
W81-05979

**RIVER QUALITY ASSESSMENT: THE BASIS FOR MANAGEMENT DECISIONS,**
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 6A.
W81-05981

**CHANGES IN SOIL WATER QUALITY RESULTING FROM THREE TIMBER CUTTING METHODS AND THREE LEVELS OF FIBER UTILIZATION,**
Montana Univ., Missoula. School of Forestry.
For primary bibliographic entry see Field 5B.
W81-05988

# 6. WATER RESOURCES PLANNING

## 6A. Techniques Of Planning

**ALLUVIAL AQUIFER OF THE CACHE AND ST. FRANCIS RIVER BASINS, NORTHEASTERN ARKANSAS,**
Geological Survey, Little Rock, AR. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05726

**GEOLOGY AND HYDROLOGY FOR ENVIRONMENTAL PLANNING IN MARQUETTE COUNTY, MICHIGAN,**
Geological Survey, Lansing, MI. Water Resources Div.
For primary bibliographic entry see Field 7C.
W81-05732

**THE FEDERAL COASTAL PROGRAMS REVIEW; A REPORT TO THE PRESIDENT,**
National Oceanic and Atmospheric Administration, Washington, DC.
For primary bibliographic entry see Field 6E.
W81-05766

**REGIONAL WATER SUPPLY SYSTEM DESIGN FOR THE FOX VALLEY,**
Illinois State Water Survey, Urbana.
For primary bibliographic entry see Field 6D.
W81-05798

**PROJECT GRANT ALLOCATION PROCESS APPLIED IN SEWERAGE PLANNING,**
Nihon Suido Consultants Co. Tokyo (Japan).
For primary bibliographic entry see Field 6C.
W81-05806

**ANALYZING FLOODPLAIN POLICIES USING AN INTERDEPENDENT LAND USE ALLOCATION MODEL,**
Illinois Univ. at Urbana-Champaign. Dept. of Landscape Architecture.
For primary bibliographic entry see Field 4C.
W81-05817

**DESIGN DISCHARGE AS A RANDOM VARIABLE: A RISK STUDY,**
Montreal Univ. (Quebec).
F. Ashkar, and J. Rousselle.
Water Resources Research, Vol 17, No 3, p 577-591, June, 1981. 11 Fig, 8 Ref.

Descriptors: *Risks, *Flood forecasting, *Reservoir design, Model studies, *Design flow, Flood discharge, Flood recurrence interval, Mississippi River, Probability distribution.

Two stochastic partial duration models were evaluated for flood analysis. The first treats flood exceedance as mutually independent and identically distributed; the second accounts for seasonal variations. The maximum likelihood estimates of the parameters appearing in each of the two models were obtained, and the probability density functions of these estimates were determined. Then (1) distribution functions of the design exceedance

corresponding to a given return period and to n years of record and (2) the return period corresponding to a given discharge and n years of record were reduced. Finally, the risk encountered in the construction of a hydraulic project based on a certain design discharge was studied. The methods were applied to flood data on the Mississippi River at St. Paul, Minnesota. The second model was less restrictive than the first and is preferred for use in risk analysis. (Cassar-FRC)
W81-05821

**OPTIMAL SHORT-TERM HYDRO SCHEDULING FROM THE PRINCIPLE OF PROGRESSIVE OPTIMALITY,**
Institut de Recherche de l'Hydro-Quebec, Varennes.
A. Turgeon.
Water Resources Research, Vol 17, No 3, p 481-486, June, 1981. 5 Fig, 5 Tab, 28 Ref.

Descriptors: *Reservoir operation, *Multireservoir networks, *Hydroelectric plants, Computer programs, Optimization.

An efficient computer program based on the principle of progressive optimality for determining the optimal short-term scheduling of a multireservoir power system is presented. The method considers water head variation, spilling, and time delays between upstream and downstream reservoirs. The convergence is monotonic and, unlike any variation method, a global optimum is reached. The state variables do not have to be discretized, and consequently a more precise solution is reached. The program is used to solve a problem of four reservoirs in series. (Cassar-FRC)
W81-05824

**COMPUTER MODEL FOR SMALL-SCALE HYDROPOWER POLICY ANALYSIS,**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
P. H. Kirshen, and J. S. Amlin.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 61-76, March, 1981. 4 Fig, 4 Tab, 13 Ref.

Descriptors: *Hydroelectric power *Licensing, *Water resources development, Legal aspects, Electric power production, Water policy, Project planning, Planning, Simulation, Economic aspects, Model studies, Computer models, *New England.

HYDRO-1 is a computer model which simulates some major factors (economics, licensing, construction, and retirement) that encourage or discourage small-scale hydropower development in New England. Results show that the most promising developers are municipalities and investor-owned utilities. Private developers could find small-scale hydropower development attractive if given financial incentives. Industrial developers would not be interested because of the short payback periods required. Computer runs indicate that development is sowed if entrepreneurs make decisions based on current value of hydroelectric power rather than on a forecasted value and if they are not given credits by the public utilities. Developers are weakly sensitive to licensing delays and to requirements and simplifications of the regulatory process. By the year 2000 sites may be feasible developed at double the present costs. At present, small-scale hydropower development will occur if developers are willing to assume risks of using power prices projected for the time plants start up production. Major deterrents for this development appear to be inflationary effects of licensing delay and the complexity of the process. (Cassar-FRC)
W81-05854

**SOME REFLECTIONS ON RIVER BASIN MANAGEMENT,**
Johns Hopkins Univ., Baltimore, MD.
A. Wolman.
Water Science and Technology, Vol 13, No 3, p 1-6, 1981. 2 Ref.

Descriptors: *Planning, *Rivers, *Water management, Water pollution control, *Watershed management, Multipurpose projects, Forecasting, Water resources development, Reviews, Evaluation.

Introducing a series of papers on river basin management, the author calls on 50 years' experience and states that planning is an art. River planning must be viewed as a continuing process, not as a finished, inviolate set of projects. Even 5-year plans are rarely fulfilled because too many variables cannot be foreseen. Piecemeal plans have had more success in the past, especially in pollution control. Multi-purpose use of river basins is a relatively recent phenomenon. Evaluations and post-audits of these projects are relatively rare, but would be valuable in avoiding similar mistakes in future planning. River basin planning must be approached on an individual basis; no two rivers are alike with respect to social, economic, and political environment. (Cassar-FRC)
W81-05976

**RIVER QUALITY ASSESSMENT: THE BASIS FOR MANAGEMENT DECISIONS,**
Geological Survey, Reston, VA.
D. A. Rickert.
Water Science and Technology, Vol 13, No 3, p 189-210, 1981. 10 Fig, 2 Tab, 18 Ref.

Descriptors: *Decision making, *Oxygen depletion, *Rivers, *Water quality control, Dissolved oxygen, Willamette River, Oregon, Water management, Model studies, Mathematical models, Biological oxygen demand, Flow augmentation, Low flow, Ammonia, Effluent standards, Nitrification, Industrial wastes, Planning.

The U.S. Geological Survey began its river quality assessment program in 1973 with a prototype study of the Willamette River, Oregon. During 1975-1978 the program was expanded to the Upper Chattahoochee, Georgia, and the Yampa, Colorado/Wyoming, basins. River basins involved in ongoing studies are Carson-Truckee, California/Nevada; Jordan, Utah; Schuylkill, Pennsylvania; Potomac Estuary, Virginia/Maryland; and Apalachicola, Florida. The goals of the river quality assessment program are to provide technically sound information appropriate for sound resource planning and management. The dissolved oxygen depletion in the Willamette River is the sample problem described in detail to illustrate how the results are produced, presented, and used. To achieve desired dissolved oxygen standards, the following possible alternatives were obtained: continuation of flow augmentation in summer to produce a minimum 170 cu meters per sec at Salem, reduction of ammonia loading, reduction of benthic demand in Portland Harbor, and increased efficiency of BOD removal at larger municipal plants and selected industrial plants. The conclusions guided the Oregon Department of Environmental Quality in planning corrective measures. The Boise Cascade Mill, the largest ammonia discharger, was limited to 3409 kg per day for the rest of the year. The importance of maintaining the minimum flow at 170 cu meters per sec was reaffirmed. The department abandoned firm plans to limit wastewater treatment plant effluent to 10 mg BOD5 per liter after the model showed this would have little advantage. (Cassar-FRC)
W81-05981

**SIMULTANEOUS ESTIMATION OF JOINTLY DEPENDENT RECREATION PARTICIPATION FUNCTION,**
California Univ., Berkeley. Dept. of Agricultural and Resource Economics.
M. F. Caswell, and K. E. McConnell.
Journal of Environmental Economics and Management, Vol 7, No 1, p 65-76, March, 1980. 5 Tab, 16 Ref.

Descriptors: *Recreation, Boating, Swimming, Fishing, *Rhode Island, *Model studies, Prediction, Forecasting, Recreation participation.

A simultaneous model of recreation participation was developed and applied to summer recreational activities in Rhode Island. It is based on the premise that participation in one activity, such as boating, is influenced by and influences participation in other activities, such as fishing. The simultaneous logit model developed by Schmidt and Strauss (1975) was used. Results indicated that simultaneous equation models produced better forecasts of recreational activities. There was high correlation between the following pairs of activities: boating and fishing, picnicking and sightseeing, and freshwater swimming and saltwater swimming. (Cassar-FRC)
W81-05983

**ESTIMATION OF BACKGROUND LOADINGS AND CONCENTRATIONS OF PHOSPHORUS FOR LAKES IN THE PUGET SOUND REGION, WASHINGTON,**
Geological Survey, Seattle, WA.
For primary bibliographic entry see Field 2H.
W81-05993

**ZAIRE'S HYDROPOWER.**
International Water Power and Dam Construction, Vol 32, No 2, p 50-52, February, 1980. 1 Fig, 1 Tab.

Descriptors: *Hydroelectric power, *Developing countries, *Dams, Hydoelectric plants, Electric power production, River basin development, Rivers, *Zaire River, Zaire, *Africa.

The development of hydropower in Zaire centers around the vast Inga Shaba project, which generates power at Inga II on the Zaire River and transmits it 1700 km to Kolwezi. The ultimate capacity of the transmission line is 1120 MW. Supplies for these water resources development projects had to be shipped from other countries and offloaded for river tansport. More than 6500 km of roads were built or improved, and ten river crossings, by ferry or temporary bridges, were required. The newer Inga system was linked with the existing Shaba system for logical and political reasons. Zaire has undergone many social, political, and technical problems. The Inga Shaba project will enable the country to export electric power and overcome some of its economic problems. Plans include building several more dams on the Zaire River. One proposed plan, Grand Inga, would dam the whole of the Zaire and bring the region's installed capacity to 39,670 MW. This complex could produce energy equal to more than 25% of the world's hydropower output. (Small-FRC)
W81-06006

## 6B. Evaluation Process

**WATERWAYS AND RELATED RIVER DEVELOPMENT: GROWTH AND CHANGE IN THE YAZOO-MISSISSIPPI DELTA,**
G. E. Galloway, Jr.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980, p 189-208, 6 Fig, 3 Tab, 15 Ref, 2 Append.

Descriptors: *Water resources development, *Navigation, *Flood control, Navigable rivers, Waterways, Transportation, Yazoo Delta area, Mississippi.

The specific causes of growth and change in a region are normally difficult to pinpoint: however, in a limited number of cases the significant contribution to this growth and change of one or two factors is so apparent that a cause-effect relationship can be postulated. Such is the case with the Yazoo Delta area of Mississippi, a distinct region where economic, socio-cultural and environmental growth and change may be traced to the impacts of river transportation and related water resources development activities. Historical analysis of the early development of the region, coupled with evaluation of more recent growth and change, highlights the importance water resources development. In its early days, the Delta required water transport to provide access to and from its fertile agricultural land. As river transport was replaced

by rail, the importance of flood control activities grew until, with the recognition in 1927 of the national impact of major flood disasters, it became a governing consideration. Growth could take place only where flood control was present. Analysis of recent growth patterns indicates some renewed attraction of the river port, not only for those industries using the port, but the ports' roles as agglomeration centers for manufacturing. (Moore-SRC)
W81-05745

**SELECTED ECONOMIC IMPACTS OF OHIO RIVER AND OHIO RIVER BASIN FEDERAL WATER RESOURCES INVESTMENT,**
C. A. Berry.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-I, 1980. p 221-241, 4 Fig, 5 Tab, 6 Ref.

Descriptors: *Waterways, *Navigation, *Flood control, *Recreation, *Stream flow, *Economic impact, Ohio River, Water resources development, Cost-benefit analysis, River flow, Transportation, River basin development.

The history of the Ohio River has been influenced significantly by development of its water resources. The Basin contains major portions of seven states (30% to 95% of the states) and smaller portions of seven other states (1% to 20%) in the area adjacent to the Ohio River. Eight rivers serve the area, the Ohio River being the prime river. Benefits to the area have accrued from improvements in navigation, flood control, recreation, and sustained stream flow. Volume of shipments on the Ohio River alone has increased five times since 1950. Transportation costs of water transport are approximately one-third those of the next cheapest mode. Transportation savings were estimated to be $500 million annually in 1977. Projects providing this saving have cost $1.3 billion on the Ohio River. Flood damage prevented has been in excess of $5 billion prevented at a cost of $3 billion. Recreation value in terms of number of recreation visits and a $1.50 value per visit are $20 million annually at a cost of $16 million. Further, from 1950-1978, approximately $64 billion in private investment has occurred in the Basin and those firms expanding or locating acknowledge water resources improvements as the prime location determinant. The total cost of water resource improvements is estimated, since 1954, to total $4.0 billion.
W81-05747

**EVALUATION OF UNDERUTILIZED RESOURCES IN WATER RESOURCE DEVELOPMENT,**
Mountain West Research, Inc., Tempe, AZ.
J. A. Chalmers, and J. R. Threadgill.
Water Resources Research, Vol 17, No 3, p 455-461, June, 1981. 1 Tab, 21 Ref.

Descriptors: *Water resources development, *Economic evaluation, *Labor, Planning, Evaluation, Monetary returns, Costs, Unemployment, Employment, Underutilized resources.

An important factor in evaluating the true economic cost of water resource development projects is the existence of unused and underused resources. Recent interest in the socioeconomic impact during project construction points to the importance of the level of local resource utilization in project assessment procedures. This paper reviews the economics literature on underutilized resources. Two empirical attempts to adjust for underused resources in the evaluation of public expenditures are discussed. It is necessary to know not only the prior labor force status of the workers on a project but also the size of the labor force and the number of unemployed persons under both 'with' and 'without' project conditions. If there is migration from the rest of the country into the project area, labor market changes in the rest of the nation must also be considered. Since it is impossible to model the labor changes in the entire country, the local changes must be carefully documented. The resulting estimates of changes in labor force will provide lower bound estimates of the downward adjustments in monetary costs. (Cassar-FRC)
W81-05809

**FINANCIAL FEASIBILITY OF HIGH DENSITY OYSTER CULTURE IN SALTMARSH PONDS WITH ARTIFICIALLY PROLONGED TIDAL FLOWS,**
Rhode Island Univ., Kingston. Dept. of Resource Economics.
N. P. Walker, and J. M. Gates.
Aquaculture, Vol 22, No 1/2, p 11-20, January, 1981. 5 Tab, 3 Ref.

Descriptors: *Aquaculture, *Oysters, *Salt marshes, *Financial feasibility, *Economic aspects, Tidal marshes, Flow, Tidal amplitude, Ponds, Feasibility studies, Costs, Cost-benefit analysis, Estuaries, Estuarine environment, Budgeting.

The economic feasibility of a modified technique for the string culture of oysters is considered. The culture method involves excavating a pond within a tidal marsh, which enhances food concentrations, water temperature, access, and control over production, as well as protection from storms. Eighty percent of the capital and labor costs are attributable to pond construction. A capital budget analysis for a 9100 square foot oyster facility showed that the system is economically attractive at product prices above 35 dollrs per bushel and discount rates of 12.5 percent or less. Since 58 percent of operating costs are for labor, there are significant economies of scale. The internal rate-of-return would be greatly increased if uniform oyster size could be achieved; however, the crowded growth conditions of the tidal pond limit the ability to control product shape and size. (Titus-FRC)
W81-05868

**SPRINKLERIRRIGATION RAISES YIELDS - AND COSTS - OF IMPERIAL VALLEY ALFALFA,**
Science and Education Administration, Brawley, CA.
For primary bibliographic entry see Field 3F.
W81-05885

**ECONOMIC MODEL FOR URBAN WATERSHEDS,**
Georgia Inst. of Tech., Atlanta.
T. N. Debo, and G. N. Day.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 475-487, April, 1980. 2 Fig, 3 Tab, 4 Ref.

Descriptors: *Computer models, *Urban watersheds, *Flood forecasting, Watersheds, Costs, Economic aspects, Flooding, Water resources development, Planning.

An economic computer model was developed that can be used to calculate benefits and costs associated with urban flooding problems and different flood mitigation measures. The input data can be varied to produce preliminary planning alternatives or detailed analysis of final alternatives. The model allows the user to specify the degree of nonstructural measure used in different zones. The model has been applied to several drainage areas in Georgia and will be used to document potential flood damage. The model is written in FORTRAN; a copy of the computer program is available from the author. In current applications, computer costs from $2 to $10 are typical for runs. The model is valuable for the water resources planner. (Small-FRC)
W81-05900

## 6C. Cost Allocation, Cost Sharing, Pricing/Repayment

**PROJECT GRANT ALLOCATION PROCESS APPLIED IN SEWERAGE PLANNING,**
Nihon Suido Consultants Co. Tokyo (Japan).
Y. Hagihara, and K. Hagihara.
Water Resources Research, Vol 17, No 3, p 449-454, June, 1981. 6 Fig, 1 Tab, 10 Ref.

Descriptors: *Grants, *Governmental interrelations, Model studies, Planning, Sewerage, Local governments, *Sewage systems.

The problem of allocating sewerage funds from a central government to local governments is handled with a model providing for information exchange between the two levels of government. First, a regional linear programming model is set up, then decisions are made using the decomposition principle. The procedure is illustrated with a case study of three Japanese cities along the Kaname River. Final allocations of the grant were 29 billion yen for the first city, 1.6 billion yen for the second, and 5 billion yen for the third. Waste reduction loads for the three cities were 31.2, 5.2, and 11.0 tons per day, respectively. (Cassar-FRC)
W81-05806

**CAPITAL COST OF RURAL WATER DISTRIBUTION SYSTEMS,**
Ohio State Univ., Columbus. Dept. of Civil Engineering.
E. E. Whitlatch, and P. L. Asplund.
Water Resources Bulletin, Vol 17, No 2, p 310-314, April, 1981. 2 Tab, 7 Ref.

Descriptors: *Water distribution, *Cost analysis, Water resources development, Cost-benefit analysis, Costs, Capital costs, Estimated costs, Economic aspects, Rural areas.

The main objective of this study was to present reliable and timely estimates of the cost of installed components of a rural water distribution system. The items included are ground and elevated steel storage tanks and the components of the pipeline system. This includes meters, polyvinyl chloride pipe, asbestos cement pipe, individual pressure reducing valves, and hydrants. The analysis also includes the cost of boring and jacking cased and uncased pipe under roads, cased pipe under railroads, and pipeline stream crossings. Information is not included on the cost of booster pumping stations, telemetering, road repair, butterfly valves, nor the fees associated with engineering or legal services. Cost data analyzed herein accounts for 92% of the capital cost of the water distribution pipelines studied. Such information can be used to design economical rural water supply systems from a capital cost standpoint. Data could be used in linear or nonlinear programming optimization models aimed at least cost design. (Baker-FRC)
W81-05957

**COSTS OF MAINTAINING PUBLIC HEALTH STANDARDS FOR SPRAY IRRIGATION OF MUNICIPAL WASTE WATER SYSTEMS,**
Economics Research Service, Washington, DC. Natural Resource Economics Div.
E. E. Young.
Journal of Environmental Quality, Vol 9, No 3, p 354-358, July/September, 1980. 1 Fig, 4 Tab, 10 Ref.

Descriptors: *Waste water treatment, *Economic aspects, Costs, *Spray irrigation, Irrigation, Municipal wastes, Land disposal, Human diseases, Public health, Simulation analysis, Waste water irrigation.

Alternative means for controlling potential public health problems associated with the land application of municipal effluents are evaluated from a cost standpoint. A cost simulation model and previously published cost estimates are used to perform the evaluation. Alternatives examined are assumed to meet a minimum level of disease prevention. Depending on the circumstances, any of the alternatives evaluated may be cost effective. When chlorination provides a sufficient level of disinfection, it appears to be the least-cost alternative. Two alternatives, substitution of surface for spray irrigation when surface terrain permits and the use of buffer zones when land costs are low, are also likely to be cost effective. Buffer zones in excess of 500 meters can be cost effective, depending on the initial land costs and whether or not the

buffer zones can be farmed. Substitution of surface irrigation, where practical, for center pivot irrigation is less costly than four weeks of storage or filtration. Filtration is more costly than four weeks of waste water storage. (Baker-FRC)
W81-05964

**ECONOMIC INCENTIVES IN RIVER BASIN MANAGEMENT IN YUGOSLAVIA,**
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
M. Miloradov.
Water Science and Technology, Vol 13, No 3, p 277-283, 1981. 1 Tab, 4 Ref.

Descriptors: *Water management, *Taxes, *River basins, Water quality control, Water pollution control, *Economic aspects, *Yugoslavia, Decision making, Pollution taxes, Legal aspects, Water policy, Water resources development, Water law.

Water management decisions in Yugoslavia have been the responsibility of the 6 republics and 2 autonomous provinces since 1974. A system of economic incentives has been developed to encourage water quality protection and water conservation and for water resources development. Money for water management projects comes from income taxes on companies and individuals (0.2-0.8% of net income), used water taxes, discharges taxes, charges for sand, gravel, and stone removal in rivers and on banks, and local government contributions. Tax rates vary considerably among the different political sudivisions and for different uses and pollutant loads. The 5-6 year experience with economic incentives as a method of water management is considered good. (Cassar-FRC)
W81-05982

## 6D. Water Demand

**EVALUATION OF SELECTED ENVIRONMENTAL SOCIO-ECONOMIC AND INSTITUTIONAL EFFECTS OF IMPLEMENTATION OF THE FEDERAL WATER CONSERVATION AND REUSE POLICY IN A RIVER BASIN WITH A WATER SURPLUS (THE WASHINGTON COUNTY, TENNESSEE PORTION OF THE FRENCH BROAD RIVER BASIN),**
East Tennessee State Univ., Johnson City.
For primary bibliographic entry see Field 6E.
W81-05706

**REGIONAL WATER SUPPLY SYSTEM DESIGN FOR THE FOX VALLEY,**
Illinois State Water Survey, Urbana.
K. P. Singh.
In: Proceedings of International Symposium on Water Resources Systems, December 20-22, 1980. Roorkee, India. p 57-63, (1981). 8 Fig, 2 Tab, 7 Ref. (Illinois State Water Survey Reprint Series No 489).

Descriptors: *Water demand, *Hydrologic models, *Aquifers, *Water resources development, Wells, Conveyance structures, Groundwater basins, Water shortage, Water table fluctuations, Piezometry, Well capacity, Cost analysis, Fox River Valley, *Illinois, Surface water, Groundwater availability.

Twelve of the 20 towns in the Fox River Valley can meet their future water demands adequately. The other eight, with 80% of the population, have limited groundwater potential and need to develop an economical, adequate, and dependable water supply. A water demand model was developed to estimate future demands. Kane County uses groundwater in several aquifers, surface water in the Fox River, and water from Lake Michigan. The shallow aquifers include sand and gravel and Silurian dolomite formations. The total potential with primary development in sand and gravel is much higher than with dolomite, but the choice will depend on technical feasibility and economics. The cost functions considered, in 1980 dollars, were for: wells and pumps, water conveyance, a reservoir, water treatment, and groundwater availability. Water for the system will be drawn from the Fox River and pumped into the reservoir. When released, it will be treated and piped to a central location in each of the eight towns. A groundwater collection system will collect water from well fields and pump it to the reservoir when supplies from the rivers are insufficient. Existing municipal well data indicate that wells with a capacity of 4 mld or more can be developed in the deep sandstone throughout the county. Construction schedules for the system components were designed to have the system operative five years after beginning construction in July 1980. Two alternative plans to meet water demands involved the conjunctive use of Fox River water, groundwater from deep wells that would not exceed the long-term sustained yield of that aquifer, or water from Lake Michigan. (Atkins-Omniplan)
W81-05798

**VERIFICATION OF THE POTENTIAL YIELD OF THE SHALLOW DOLOMITE AQUIFER IN DUPAGE COUNTY, ILLINOIS,**
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2F.
W81-05800

**PLANNING FOR DROUGHT: A MANAGEMENT PERSPECTIVE,**
Corps of Engineers, Baltimore, MD.
For primary bibliographic entry see Field 6E.
W81-05853

**CANADA-U.S. WATER MANAGEMENT: NEW PROGRAMS FOR NEW CHALLENGES,**
Inalnd Waters Directorate, Ottawa (Ontario).
N. H. James, and S. L. Fenety.
Water Science and Technology, Vol 13, No 3, p 49-59, 1981.

Descriptors: *Water quality control, *River basins, *Great Lakes, *Canada, *Water management, Water law, Water policy, Water pollution control, Legal aspects, Lakes, Boundary disputes, *International agreements, International commissions, Hydroelectric plants, Powerplants, Irrigation, Drought, Flood control.

Canada and the U.S. have cooperated in water management of shared resources through the International Joint Commission, the Boundary Waters Treaty (1909), and the Great Lakes Water Quality Agreement (1972). The major challenges are: (1) energy projects, such as the proposed coal-fired power plant at Coronach, Saskatchewan, hydroelectric power plants, and acid rain; (2) persistent toxic pollutants in the food chain, in particular, mirex, Hg, and polychlorinated biphenyls; (3) water diversion for irrigation and drought proofing in the Prairie states, and (4) flood control. Of the above, all but pollution are addressed by existing treaties. To improve cooperation, joint basin planning and management is of prime importance, but it is not appropriate in the context of the political situation in both countries. Other solutions are strengthening the International Joint Commission or a more finite definition of the international obligations under Article IV of the Boundary Waters Treaty. In other words, specific water quality parameters would be established for the border lakes and the rivers and streams flowing across the border. The means of maintaining the specified water quality would be the responsibility of each country. (Cassar-FRC)
W81-05979

**WATER - THE SINE QUA NON OF LIFE,**
University Clinic for Infectious Diseases, Copenhagen (Denmark).
T. Mikkelsen.
Aqua, No 2, p 38-43, 1980. 5 Fig, 2 Tab.

Descriptors: *Water policy, *Public health, *Water use, Diseases, Water resources, Irrigation water, Drinking water, Water pollution, Water quality, Planning.

Water, an essential non-renewable resource, has been polluted and overburdened with wastes during the past 100 years. The oceans, containing 1370 million cu km of water, receive wastes and provide food (fish, lower orders of protein foods, seaweeds, and algae) and pharmacologically important animals and compounds (horseshoe crabs, carrageenan, alginates, hormones, sterols, terpenes, and others). Drinking water is used at the rate of 200-600 liters per day in developed countries, much more than the 20 liters necessary for most humans. The ravages of water-borne disease and poor sanitation can be considered to represent a drain on the food energy demand. In some developing countries, where much of the population suffers from disease, the food burden to compensate for illness is an additional 7500 tons of rice per month per million persons. Projections of irrigation requirements for the year 2000 are 4,250 billion cu meters. It is extremely important to irrigate efficiently, avoiding excessive runoff and contamination by chemicals. Irrigation water conveyances and other water resource development projects have been responsible for introduction and spread of water related diseases such as schistosomiasis and malaria. Future use of water resources may include iceberg towing, supertankers carrying water, and aquaculture. Clean water must be priced high enough to prevent waste and discourage pollution. (Cassar-FRC)
W81-06038

**THE DESERT BLOOMS - AT A PRICE,**
For primary bibliographic entry see Field 6G.
W81-06043

## 6E. Water Law and Institutions

**EVALUATION OF SELECTED ENVIRONMENTAL SOCIO-ECONOMIC AND INSTITUTIONAL EFFECTS OF IMPLEMENTATION OF THE FEDERAL WATER CONSERVATION AND REUSE POLICY IN A RIVER BASIN WITH A WATER SURPLUS (THE WASHINGTON COUNTY, TENNESSEE PORTION OF THE FRENCH BROAD RIVER BASIN),**
East Tennessee State Univ., Johnson City.
C. S. Bishop, G. T. Broach, W. H. Hester, and V. Sikora, III.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108507, Price codes: A08 in paper copy, A01 in microfiche. Tennessee Water Resources Research Center, University of Tennessee, Knoxville, Research report No 85, April, 1981. 160 p, 31 Tab, 110 Ref. OWRT-B-049-Tenn(1), 14-34-0001-0281.

Descriptors: *Water conservation, *Water management, *water policy, *water utilization, rationing(Water), *Water demand, Water reuse, Legal aspects, Economic agents, Social agents, Water treatment facilities, Care studies, *French Broad river basin, Tennessee.

The importance of water conservance has been emphasized by a proposed National Water Policy which was announced by President Carter on June 6, 1978. this policy stressed water conservation and reuse on a national scale. Such a policy seeks to apply one program to all water resource problems. Consideration must be given to those vast areas of the country which inreaity do not have a shortage of water. One of these areas is the French Broad River basin of Tennessee. This report was formulated in an effort to describe both the positive and negative effects of water policies which would bring about either a 10% or 30% reduction in water usage in this basically water-rich area. the parameters used in the evaluation included selected economic, sociological, legal, and environmental impacts.
W81-05706

**THE FEDERAL COASTAL PROGRAMS REVIEW; A REPORT TO THE PRESIDENT,**
National Oceanic and Atmospheric Administration, Washington, DC.
Report, January, 1981. 374 p, 4 Fig, 3 Tab, 149 Ref, 4 Append.

Descriptors: *Coastal zone management, *Federal jurisdiction, *Public policy, *Governmental inter-

relations, Ecosystems, Natural resources, Regional development, Land use, Public access, Energy sources, Planning, Economic aspects, Federal coastal programs, Reviews.

This report is the response to a presidential memorandum seeking a review of all federal programs significantly affecting coastal resources and to evaluate and identify conflicts in policies and objectives of existing programs; determine whether these programs are being implemented in a consistent and coordinated fashion; and determine if any program contributes to uneconomical or environmentally unsound development activities affecting critical natural systems. Since nearly all Federal programs affect coastal resources the scope of the report was limited to five broad areas. They are: development and reconstruction assistance in coastal hazard areas; infrastructure development in coastal areas; access to Federal lands in the coastal zone; Federal programs related to energy development; and improved coordination for planning and permitting in special coastal areas. The report was conducted in cooperation with other Federal agencies, and the recommendations generally reflect agreement among them. Dissenting opinions from agencies are given in each chapter. The recommendations attempt to balance the diverse demands on coastal resources by competing national, state, local, public and private interests and recognize that the coastal resources are finite, and that the Federal budgetary resources are limited. (Brambley-SRC)
W81-05766

**INDUSTRIAL WASTE INSPECTION PROCEDURE FOR A REGIONAL AUTHORITY,**
Massachusetts Metropolitan District Commission, Boston. Sewerage Div.
N. D. Baratta, and W. T. Grandin.
Public Works, Vol 112, No 5, p 77-80, May, 1981.

Descriptors: *Industrial wastes, *Inspection, *Industrial waste water, *Water quality standards, Waste water treatment, Waste water disposal, Regulations, Dicharge measurement, Hazardous materials, Pretreatment of water, Waste water facilities, Water pollution prevention.

The Metropolitan District Commission (MDC) Sewerage Division of Boston has started an industrial wastes inspection procedure that may be applied to pretreatment as well as hazardous waste control programs. Preparation for inspection involves obtaining lists of all industries within the municipality. At an initial inspection, sewer use rules and regulations are reviewed with the help of city officials and other professionals. An interview is scheduled between the appropriate industrial personnel and the MDC team members to discuss wate usage figures, waste discharge, pretreatment procedures, heating and cooling systems, and storage of toxic wastes. A tour of the facility is conducted to verify information obtained during the interview and to check for posible violations. A summary of the investigation is written. Follow-up inspections may be required to see if violations really exist or if corrections on previously noted violations have been implemented. Although the law defends the right of the MDC to conduct inspections, in cases where the industrial representative is uncooperative, diplomatic measures are recommended, rather than an authoritative approach, to maintain a good rapport with local industries. This inspection program has been successfully employed by the MDC for the past six years. (Geiger-FRC)
W81-05831

**LABORATORY CERTIFICATION AND QUALITY ASSURANCE,**
Connecticut Dept. of Health Services, Hartford.
E. R. Thompson, Jr.
Journal of the New England Water Works Association, Vol 95, No 1, p 51-53, 1981.

Descriptors: *Water analysis, *Laboratories, *Quality control, Pollutant identification, *Connecticut, Certification, Safe Drinking Water Act.

The State of Connecticut Laboratory Certification Program existed many years before the Safe Drinking Water Act required laboratory certification. The program is divided into four areas: certification of laboratory directors, certification of the laboratory, performance evaluation samples, and consultation. The laboratory director must fulfill certain education and experience requirements and pass an examination with a grade of 70 or better. Laboratory certification entails on-site evaluation. Performance samples are analyzed yearly, the results statistically analyzed, and ratings assigned according to a point system. Consultation is available for any laboratory upon request, especially for those with problems. (Cassar-FRC)
W81-05845

**LABORATORY CERTIFICATION AND QUALITY ASSURANCE,**
Connecticut Dept. of Health Services, Hartford.
J. S. Tucker.
Journal of the New England Water Works Association, Vol 95, No 1, p 48-50, 1981.

Descriptors: *Laboratories, *Regulations, Legal aspects, *Connecticut, Water analysis, Pollutant identification.

The Laboratory Division of the Connecticut Department of Health Services is responsible for the licensure, registration, approval or certification of 400 facilities throughout the state. These perform tests on water, waste water, sewage, etc. A staff of 11 people enforces regulations of the Safe Drinking Water Act, the National Pollution Discharge Elimination Systems, Etc. the maze of regulations frequently emphasizes procedures at the expense of assuring compliance. As regulations are being drafted it is important for all those involved, including the citizen paying the bill, to input their opinions. Only in this way can regulation be practical and cost effective. (Cassar-FRC)
W81-05846

**VALUES AND UTILITY REGULATION,**
Notre Dame Univ., IN. Dept. of Philosophy.
J. P. Desjardins.
Journal of the New England Water Works Association, Vol 95, No 1, p 1-12, March, 1981. 5 ref.

Descriptors: *Utilities, *Regulations, *Policy making, *Decision making, Value, Management planning, Illinois Commerce Commission, *Social aspects, Economic aspects.

A survey of the values and principles which guide utility regulators and management was done by an interdisciplinary group at the University of Notre Dame. Subjects of the study were members of the Illinois Commerce Commission, the state's utility regulatory board, and utility executives. Regulators viewed the public as a broad constituency comprising utility consumers and non-consumers, stockholders, investors, employees and future generations. They viewed the public interest basically as an economic interest, with the public free to spend income on whatever it chooses. Progress was seen as improvement in the quality of life rather than growth in GNP. Most agreed that rates should not be used to resolve social inequalities. They did not equate public need with public demand. Regarding energy conservation, a majority agreed that present rates of energy consumption must decrease. Although utility executives had similar values in some respects, they viewed their constituency in a narrower sense--their own consumers, stockholders, investors, and employees. They believed that public need should be measured by public demand. Nuclear power was considered the most promising answer for energy needs; most did not believe energy consumption must decrease. There was a reluctance by both industry and regulators to accept primary responsibility for initiating policy to serve the public interest. The dominant thinking pattern used by both groups wasutilitarian, which makes decisions solely in terms of the consequences involved, e.g. cost/benefit analysis. The study concluded that the regulatory body is not controlled by industry, but is presently somewhere between the two extremes of capture and total independence. (Cassar-FRC)
W81-05848

**CHANGING OBJECTIVES: CHICAGO METRO FLOODWATER PLAN,**
Illinois State Dept. of Transportation, Chicago. Div. of Water Resources.
F. L. Kudrna, and R. K. Olson.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 13-25, March, 1981. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Flood control, *Floodwater, *Planning, *Chicago, Illinois, Erosion control, Sediment control, Recreation, Nonstructural alternatives, Channel improvement, Regulations, Reservoirs, Urban areas, Water management, Water policy.

The Chicago Metropolitan area experienced an urgent need to formulate floodwater management plans acceptable to the public and to the federal agencies granting implementation funds. Watershed steering committees were formed, with citizen, community, and agency involvement at a grass-roots level. Technical assistance was provided by the U.S. Department of Agriculture, the Soil Conservation Service, and local sponsors. Details on the Little Calumet River Watershed Plan are presented as an example of the work done by these committees. Implementation of this plan is expected to reduce annual flood damage by 98%, provide recreation facilities, reduce erosion on agricultural land from 8.4 to 3.8 tons per acre, and reduce sedimentation yield from urban land from 11 to 3.8 tons per acre. Benefit to cost ratio is 1.2:1. Features of the 10 year installation include excavated floodwater storage reservoirs, channel and dike improvement and maintenance, wetland acquisition, treatment of sediment production areas, and ordinances to control flood plain use, sediment production, and erosion. This planning effort is unique in terms of scope, public participation, and agency cooperation. The key to success is the public involvement through broad-based steering committees. (Cassar-FRC)
W81-05849

**URBANIZATION AND WATER SUPPLIES FOR NORTHEASTERN COLORADO,**
Monterey County Flood Control and Water Conservation District, Salinas, CA.
R. R. Smith.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 107, No WR1, p 1-11, March, 1981. 8 Fig, 1 Tab.

Descriptors: *Urbanization, *Water supply development, *Irrigation water, *Colorado, *Water policy, Water distribution, Water resources development, Population dynamics, Agriculture, Water rights.

Urbanization in Northeast Colorado has not resulted in a water conflict between agricultural and urban users. So far, the expanding municipal and industrial needs have been met by decreases in agricultural acreage and purchase of agricultural water rights. Colorado laws give priority to municipal-domestic users, who can afford to pay higher prices and thus develop additional water resources more readily than the farmer. The impacts of growth have been determined by comparing hydrologic data and water use for agricultural, municipal-domestic, and industrial purposes for 1975-1979. Pricing and water rights ownership were also compared for the same period, as were land conversion data, population data, and crop production valuation. The Windy Gap project is one example of a new water source scheduled to provide 50,000 acre-feet of new water annually for the Colorado River Basin at a capital cost of $700 per acre-foot. This, and proper management of all water supplies, should assure the area of a stable water supply to support both planned growth and irrigated agriculture. Urbanization requires a larger quantity of treated water than agriculture. The costs of expansion and changes in operation of the water distribution systems will be absorbed by the municipal-domestic consumers. (Cassar-FRC)
W81-05852

**PLANNING FOR DROUGHT: A MANAGEMENT PERSPECTIVE,**

Corps of Engineers, Baltimore, MD.
J. E. Crews.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Socity of Civil Engineers, Vol 107, No WR1, p 45-59, March, 1981. 6 Fig, 8 Tab.

Descriptors: *Drought, *Water shortage, *Water supply development, Regional planning, *District of Columbia, Water supply, Metropolitan water management, Water resource development, Planning.

The Metropolitan Washington, D.C., area, which depends on the Potomac River for its water supply, faces potentially severe water shortages caused by growing population and economy. The Corps of Engineers was authorized by Congress to investigate the water resource needs for the area and recommend solutions. Posible answers to the water supply problems are: water conservation and demand reduction, reregulation of existing reservoir systems, construction of a local storage reservoir, and construction of a raw water interconnection between the Potomac and other sources. These alternatives were incorporated into 5 plans--a no action plan, local and subregional plans, and 2 regional plans--involving 3 utilities, the Washington Aqueduct, the Washington Suburban Sanitary Commission, and the Fairfax County Water Authority. The local plan requires the least cooperation among utilities. A regional plan is most cost-effective and requires the most regional cooperation. The 3 suppliers have formed a task force to consider the plans and expect to have recommendations available in 1981. (Cassar-FRC)
W81-05853

**UNITED STATES V. HOMESTAKE MINING COMPANY: THAT AIN'T GOLD IN GOLD RUN CREEK,**
W. C. Garry.
South Dakota Law Review, Vol 25, No 1, p 80-90, Winter, 1980. 61 Ref.

Descriptors: *Judicial decisions, *Federal jurisdiction, *Mine wastes, Water lw, Legal aspects, Water pollution sources, Tailings, Industrial wastes, *South Dakota.

The case of United States v. Homestake Mining Company involved a question of the company's eligibility for an extension of the compliance deadline of the 1972 Clean Water Act. The company operates a gold mine and milling operation in Lead, South Dakota, which discharges waste water containing tailings, heavy metals, and suspended solids into the creek. Homestake failed to meet a July 1, 1977 water quality deadline, and the Environmental Protection Agency negotiated with Homestake in an attempt to establish a compliance schedule. To honor the agreement, Homestake had to complete a tailings pond and install a final water treatment system. When the 1977 admendments to the Act were passed, Homestake petitioned the US District Court and was granted relief from the consent decree and stipulation because Homestake had shown good faith to comply with the 1972 Act. This decision was vacated by the Eighth Circuit Court of Appeals, because Homestake's permits were based on state water quality standards rather than Federal effluent limitations. (Small-FRC)
W81-05864

**INDIAN WATER RIGHTS IN IDAHO,**
Idaho University, Aberdeen.
T. S. Longley.
Journal of the Water Resources Planning and Management Division, Proceedings of the American Society of Civil Engineers, Vol 106, No WR2, p 439-449, July, 1980. 19 Ref.

Descriptors: *Water rights, *Reservation doctrine, Legal aspects, Riparian rights, *Idaho, American Indians, Political aspects.

The history and problems involved in Indian water rights litigation are reviewed from the viewpoint of their effect on the use of water in Idaho. For the most part, Indian water rights have not been adjudicated, and thus their future uses and duties are largely open to conjecture. In many cases even their priority dates are still unsettled. Most of the problems have arisen due to unclear wording or interpretation of the original treaties or executive orders creating the reservations and the appurtenant water rights. The earliest legal case concerning waters on the reservation was that of Winters versus the United States in 1908 when the issue centered around non-Indian irrigators on lands north of the Milk River appropriating and beneficially using essentially all of the summertime flow for irrigation prior to the completion of an Indian irrigation project. A similar case, The Conrad Investment Company versus the United States, dealt with waters of Birch Creek in the summertime being diverted almost entirely for irrigation and sold to settlers. Skeem versus the United States furthered and expanded the same issue. The problem of relative rights of Indians living on the reservation or descendants of original Indian allotees on the Crow Indian Reservation was dealt with in the United States versus Powers, 1939, and the United States versus McIntire. The rights of the Secretary of the Interior were also questioned in several cases such as the United States versus the Ahtanum Irrigation District, 1956. (Baker-FRC)
W81-05896

**OVERVIEW,**
Natural Resources Defense Council, New York.
J. Warren.
Environment, Vol 23, No 4, p 2-4, May, 1981. 2 Ref.

Descriptors: *Polychlorinated biphenyls, *Electrical equipment, *Regulations, Water pollution control, *Legal aspects, Organic compounds, Standards, Chlorinated hydrocarbons.

Federal regulations have not been effective in reducing human and environmental exposures to polychlorinated biphenyls (PCBs). The net result of the past six years of PCB control efforts is some reduction of discharges into water, lowered tolerances in certain food groups (excluding fish), regulations on the installation of PCB containing equipment into certain food and feed facilities, and plans to revise the rules implementing the ban on manufacture and use of PCBs. Although zero discharge standards are in force for the manufacturers of PCB and PCB-containing electrical equipment which discharge directly into the nation's waterways, the 75% of the sources discharging waste into municipal sewage treatment plants are not regulated. Of the 750 million pounds of PCB in current commercial use, 745 million pounds is in totally enclosed electrical equipment, allowed by regulations in spite of the fact that leakage occurs. (Cassar-FRC)
W81-05948

**RIPARIAN LANDOWNERS' ATTITUDES TOWARD A STATE WILD RIVER PROGRAM,**
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. W. Roggenbuck, and K. G. Kushman.
Journal of Forestry, Vol 78, No 2, p 91-93, February, 1980. 1 Tab, 9 Ref.

Descriptors: *Public opinion, *Attitudes, *Wild rivers, Wilderness areas, Environmental policy, *Riparian land, Public policy, Surveys, Recreation, *Legal aspects.

The beliefs and feelings of riparian landowners regarding the Wisconsin Wild Rivers Act were surveyed. The questionnaire included 17 policy statements describing who might benefit from a wild river program, how much land might be affected, how the river corridors might be protected, and what landowner and recreation activities might be appropriate. An average of 33% of the respondents failed to answer each of the items testing knowledge of policy. There was substantial support for items specifying the protection of the rivers in their natural, free-flowing state, but considerable disagreement with policies to protect the land corridors adjacent to the streams. Communication is needed between the resource managers and the landowners. Landowners agreed in principle with wild river protection, but preferred innovative over authoritarian methods of accomplishing the protection. Landowners feared the influx of recreationists to the rivers. (Small-FRC)
W81-05986

**COSTS OF ALTERNATIVE POLICIES FOR CONTROLLING AGRICULTURAL SOIL LOSS AND ASSOCIATED STREAM SEDIMENTATION,**
Idaho Univ., Moscow. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W81-05987

**WESTERN WATER RESOURCES: COMING PROBLEMS AND POLICY ALTERNATIVES,**
Federal Reserve Bank of Kansas City, MO.
M. Duncan, and A. Laing.
Journal of Soil and Water Conservation, Vol 35, No 4, p 192-195, July/August, 1980. 2 Fig.

Descriptors: *Water resources development, *Water rights, Water supply development, Riparian rights, Semiarid lands, *Legal aspects, Cost analysis, Water policy.

The need to use water more efficiently is becoming understood in the western part of the United States. Questions of environmental protection and fairness are assumming increased importance to those in positions of decision making. Two fundamental problems are addressed. First is the desire of society to provide for a mix of both private and public resource development. Second is the need to harmonize both individuals and groups in decision making steps. Water policies of future need to recognize the powerful role of individual incentives. Improvements are needed in state water laws. Society must determine the appropriate role of government at various levels in water programs and policy. Special efforts should be made to reduce the uncertainty associated with group action which affects water policy. An important policy question revolves around changes in laws and institutions that presently control water resources development. Developments in western water law and practice were significantly different from those which occurred naturally in the east. Riparian water rights, common in the east, simply do not apply in the west. The doctrine of prior appropriation can come simply do not apply in the west. The doctrine of prior appropriation can come into play. In recent years water laws have been, in reality, attempts to control land use and economic development. Problems in using the cost-benefit analysis approach to determine what constitutes a beneficial use of water are cited. (Baker-FRC)
W81-05989

## 6F. Nonstructural Alternatives

**ESTIMATING PROBABILITIES OF RESERVOIR STORAGE FOR THE UPPER DELAWARE RIVER BASIN,**
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 4A.
W81-05737

**RIVER BASIN MANAGEMENT BY ECONOMIC INCENTIVES OR REGULATORY SANCTIONS--NATIONAL EXPERIENCES: ENGLAND,**
Severn-Trent Water Authority, Birmingham (United Kingdom).
W. F. Lester.
Water Science and Technology, Vol 13, No 3, p 7-21, 1981. 6 Fig, 7 Tab, 4 Ref.

Descriptors: *Water quality control, *River basins, *Regulations, Water law, *Watershed management, Water policy, Water management, Rivers, *Water pollution control, Administrative agencies, Severn-Trent Water Authority, *England, Pollution taxes.

For the purpose of this paper, the concept of river basin management is limited to pollution control and maintenance of specified water quality. It is concluded that, where there is a well-financed and established pollution control infrastructure, regulatory sanctions are a superior method of improving water quality. Data on water quality improvement from the rivers Trent, Tame and Avon are given as evidence. On the other hand, in areas where sufficient funds for pollution control are unavailable and where organization is divided, economic incentives combined with regulatory sanctions may have advantages in providing a first-time pollution control infrastructure. The water administration in England is described. The regional water authorities, formed in 1974, are responsible for all activities connected with the hydrologic cycle. Statistics on the Severn-Trent Water Authority are given to illustrate the responsibilities and operation of a regional water authority. (Cassar-FRC)
W81-05977

**RIVER BASIN MANAGEMENT BY ECONOMIC INCENTIVES OR REGULATORY SANCTIONS--THE GENERAL SITUATION IN SWEDEN, ILLUSTRATED BY THE GOTA RIVER CASE,**
Goteborg Regional Sewerage Co. (Sweden).
S. Hallquist.
Water Science and Technology, Vol 13, No 3, p 23-29, 1981. 3 Fig.

Descriptors: *Water quality control, *Regulations, *River basins, *Sweden, Gota River, Water pollution control, Water law, Water policy, Water management, *Watershed management, Administration, Multipurpose projects.

River basin management in Sweden consists of river boards organized on a voluntary basis. They have no executive or enforcement power (these rights are reserved for the central government), but serve control and coordination purposes. There is no specific legislation for river basin management. Some regulations for transportation of dangerous cargo exist, and there are subsidies to encourage construction of wastewater treatment plants, both industrial and municipal. The Gota River, entering the Kattegatt Strait at Gothenburg, is an example of a multipurpose use river. Water quality control measures began in 1934 with installation of sluice gates to regulate the proportion of flow from the north and south branches to prevent salt water intrusion. Expansion of a regional sewage system has added residential areas and industries, particularly a chlorine-alkali factory, which has cut its annual Hg discharges from hundreds of kg to only a few kg. Potassium permanganate consumption of the river water increased steadily from 15 pm in 1890 to a high of 60 ppm in 1970. The 1978 levels had declined to 30 ppm. The preferred method of river management in Sweden combines small economic incentives with seldom practiced regulatory sanctions. Future development will probably go in the direction of regulation. (Cassar-FRC)
W81-05978

**ECONOMIC INCENTIVES IN RIVER BASIN MANAGEMENT IN YUGOSLAVIA,**
Institut za Vodoprivredu Jaroslav Cerni, Belgrade (Yugoslavia).
For primary bibliographic entry see Field 6C.
W81-05982

## 6G. Ecologic Impact Of Water Development

**WATERWAYS AND RELATED RIVER DEVELOPMENT: GROWTH AND CHANGE IN THE YAZOO-MISSISSIPPI DELTA,**
For primary bibliographic entry see Field 6B.
W81-05745

**WHY REGIONAL DEVELOPMENT,**
L. G. Antle.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980, Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 209-220, 3 Ref.

Descriptors: *Waterways, *Water resources development, *Regional development, Planning, Water quality, Navigation, Recreation, Flood control, Hydroelectric power, Political aspects, Social aspects, Economic aspects.

The role of water resources in regional development community development, and national economic development was analyzed in relation to Corps of Engineers planning. The McClellan - Kerr Arkansas River Navigation System has a variety of impacts on both the region and the nation. Direct and indirect income effects totalled $1.9 billion from the $1.3 billion construction expenditures. Navigation traffic has increased at approximately 15% per year. Flood damages are lower by $10 million a year. The project is producing the amount of hydroelectric power anticipated. Recreation has turned into a major category of benefits. Suspended sediment loads have declined sharply. Improvement in water quality is one of the major unanticipated benefits. The Tenn-Tom project, now under construction, is almost purely navigation and recreation, and therefore lacks the multiple purpose character of the Arkansas River project and its ability to attract a variety of interest groups. It will be a thruway for commodities produced a great distance from the waterway, diffusing interests over a wide area. This has served to facilitate political support for the project. It is concluded that water resources projects and programs can be effective agents for national, regional and community development. Water resource projects should be integrated with local and regional development plans and with environmental quality plans. (Moore-SRC)
W81-05746

**SELECTED ECONOMIC IMPACTS OF OHIO RIVER AND OHIO RIVER BASIN FEDERAL WATER RESOURCES INVESTMENT,**
For primary bibliographic entry see Field 6B.
W81-05747

**THE DYNAMICS OF RIVERS AND THEIR RESPONSE TO MAN AND NATURE,**
Army Engineer Dist., Vicksburg, MS.
B. R. Winkley.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 387-406, 4 Fig, 33 Ref.

Descriptors: *Waterways, *Alluvial rivers, *Sediment transport, River basin development, Navigation, Environmental effects, Scour, River training, River flow, Flooding, Bank stabilization.

An alluvial river is a dynamic system which continually changes its position, as a consequence of hydraulic forces acting on its bed and banks. These changes may be slow or rapid and may evolve through time due to natural forces or due to man's activities. Man-induced changes frequently start a response that can be propagated for long distances. All problems in alluvial rivers are a result of sediments. Directly or indirectly, the movement and storage of sediments create all river problems, including flooding, navigation problems, excessive scour or fill around manmade structures, and environmental effects. The control of all alluvial rivers is directly associated with the geology of each drainage basin. The topography of the basin which dictates the slope of the river system, thus the energy to move or to store sediments, has been developed through geologic processes. The cure of any river navigation problem is the proper control of the slope. Most navigational improvements on alluvial rivers, including locks and dams, cutoffs, bank stabilization, realignment, and training structures, change the rivers natural slope, thus altering the movement of sediments. In the past, engineering analysis of a river has been mostly of a hydraulic and hydrologic nature. In order to better understand any river system, a fluvial geomorphic analysis is also needed. (Moore-SRC)
W81-05748

**ENVIRONMENTAL ASPECTS OF DREDGED MATERIAL DISPOSAL RELATING TO WATERWAY DEVELOPMENT,**
J. Harrison.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 495-507, 14 Fig.

Descriptors: *Waterways, *Dredging, *Waste disposal, *Water pollution sources, Spoil banks, Turbidity, Effluents, Wildlife habitats, Wetlands, Land disposal.

Maintaining navigation on approximately 25,000 mi of waterways and over 500 harbors in the United States involves the annual dredging of about 350,000,000 cu yd of material. The basic problem is not in dredging the material, but in the efficiency, effectiveness, and environmental compatibility of disposing of the material after dredging. The physical impacts of dredged material disposal in open water are, in almost all cases, potentially more dominant than the chemical effects on the biota. Physical impacts include smothering and covering benthic organisms, reducing light penetration and changing the water bottom profile. Significant problems occur when discharged dredged material produces fluid mud near the bottom of disposal areas. An often attractive alternative to open-water disposal is upland disposal. However, the effluent from containment areas and upland disposal areas may, under certain circumstances, produce more harmful effects than those produced if the material is deposited in open water. Perhaps the most desirable productive use for dredged material is creating wildlife habitats. These habitats can also serve significant other functions such as improving water quality, protecting areas from wave action, and providing recreation opportunities. (Moore-SRC)
W81-05753

**GRAND VALLEY IRRIGATION RETURN FLOW CASE STUDY,**
Water and Power Resources Service, Boise, ID.
J. W. Keys.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR2, p 221-232, June, 1981. 8 Tab, 1 Fig, 9 Ref.

Descriptors: *Irrigation, *Irrigation-return flow, *Case studies, *Percolation, *Water quality, flow, Overland flow, Agricultural hydrology, Crop production, Irrigation effects, Basin irrigation, Salinity, Nitrogen, Discharge, Grand Valley, Colorado River.

A case study of irrigation in the Grand Valley of Colorado is summarized. the magnitude of irrigation of irrigation in the area, its impact, and laws and actions being implemented to control water quality are discussed. Agriculture is the principal industry in the valley. It occupies 71,500 acres. Strongly saline parent material dominates the geology of the area. Irrigation has been underway since 1882. Currently there is an annual inflow of 4,500,000 acre-ft and an outflow of 4,300,000 acre-ft of water. Return flows are generated by four different mechanisms of the gravity system: (1) Canal seepages, (2) deep percolation from on-site use, (3) field trailwater runoff, and (4) administrative wastes from the canals. Salinity concentration of the Colorado River progressively increases downstream as a result of water diversions. (Titus-FRC)
W81-05803

**CALIFORNIA IRRIGATION RETURN FLOW CASE STUDIES,**
California Univ., Davis, Dept. of Land, Air, and Water Resources.
K. K. Tanji.
Journal of the Irrigation and Drainage Division. Proceedings of the American Society of Civil Engineers, Vol 107, No IR2, p 209-220, June, 1981. 3 Fig, 4 Tab, 10 Ref.

Descriptors: *Irrigation, *Agricultural watersheds, *Irrigation-return flow, Water quality, Discharge,

flow, Agricultural hydrology, Crop production, Irrigation effects, Basin irrigation, Salinity, Nitrogen, Irrigation canals, Rainfall, Drainage, Sacramento River, Joaquin River, California.

The impacts of irrigation return flows on the quantity and quality of the Sacramento and San Joaquin Rivers are appraised. Quantity of return flows is influenced by availability and cost of supply water, irrigation application methods, extent of reuse on site and within the basin, special cultural practices, and constraints on reuse caused by pollutants. Quality of return flows is influenced by quality of the supply water, presence of salts and chemicals native to the soils, leaching, use of manure and other agricultural chemicals, erodibility, discharges into irrigation drains, and the relative proportion of surface and subsurface flows. Analyses indicate that the quantity and quality of return flows are highly variable. Information on impacts of these flows is not yet adequate. Priority issues for agricultural planning pertain to soil erodibility and sediment production, salinity drainage in the San Joaquin Valley, impact of agricultural drains on aquatic and wildlife resources in the Colorado River Basin, and pesticide residues in return flows. (Titus-FRC)
W81-05804

**THE PASSING OF THE ATLANTIC SALMON,**
A. Netboy.
Ecologist, Vol 10, No 10, p 336-341, 1980.

Descriptors: *Salmon, *River flow, *Fish conservation, Fish migration, *Fish barriers, Fish populations, Fishing, Europe, United States, Canada, Atlantic Ocean, Ecological effects.

The Atlantic salmon (Salmo salar) lives only in the northern hemisphere between latitudes 40 to 70 degrees. Salmon were abundant in hundreds of rivers from northern Portugal to the Arctic Ocean when humans first began populating western Europe. Salmo salar criss-crossed the Atlantic for between one and four years before returning to their home rivers, where they migrated far inland to spawn. The Baltic countries, France, Portugal, Spain, the Low Countries, Scandinavia, and the British Isles all had ample runs of salmon until fairly recently. Iceland and Greenland also have small stocks. Substantial runs of salmon were common in about 25 rivers in New England during the colonial period. However, blockading of rivers to impound water for local mills and settlements disrupted salmon migratory routes both in the United States and in Europe. Habitat alteration and excessive fishing have reduced salmon levels to very small populations in most of Europe and in the United States. Canada, Scotland, Ireland, Norway, the Soviet Union, and Sweden now account for about 80 percent of the world's production of Atlantic salmon, with Finland, Iceland, England, and Wales accounting for almost all the rest. Total catches have stayed the same or declined in recent decades. Drift net fishing on the open seas intercepts salmon on their feeding migrations and prevents their return to their home rivers to spawn. Remaining stocks of salmon are threatened by excessive open sea fishing and failure to enforce existing regulations affecting spawning rivers. The results of efforts undertaken by several countries to increase salmon populations have been generally disappointing. (Carroll-FRC)
W81-05893

**EFFECTS OF RECREATIONAL RIVER TRAFFIC ON NEST DEFENSE BY LONGEAR SUNFISH,**
Water and Power Resources Service, Boulder City, NV. Div. of Planning.
G. Mueller.
Transactions of the American Fisheries Society, Vol 109, No 2, p 248-251. March, 1980. 2 Fig, 2 Tab, 7 Ref.

Descriptors: *Sunfish, *Recreation wastes, *Recreation facilities, Fish, Fishing, Public waters, Boating, Behavior, Fish behavior, *Ecological effects.

A study was conducted to determine effects of recreational boating in the Ozark National Scenic Riverways park on the reproductive processes of fish. An underwater camera was placed 1-2 meters from a nest of longear sunfish. Individual nests from five colonies were filmed. Data on nest location, water depth, nest contents, physical nature of the substrate, location of cover, predators, and associated spawning behavior were recorded at each site. Evidence of nest damage caused by propeller wash and predation activities were also studied. The nests were located in quiet areas with a chert substrate. Water depth over the nests varied but usually averaged about 75 cm. No preference for nest building near protective cover was noted. Nests were sometimes found in areas along the main stream channel, but these sites were usually protected from the current by some type of cover. Nest-guarding males (spawners) attacked by intruders that penetrated their territories. Boating affected fish behavior, depending on the speed and proximity to nests. The boats caused spawners to abandon the nests for varying periods of time. Slow-moving craft passing near a spawner chased him from his nest more often than craft moving at faster speeds. Once predation occurred, nests were increasingly vulnerable to predator attacks. (Baker-FRC)
W81-05926

**DOWNSTREAM NATURAL AREAS AS REFUGES FOR FISH IN DRAINAGE-DEVELOPMENT WATERSHEDS,**
Minnesota Univ., St. Paul. Dept. of Entomology, Fisheries and Wildlife.
J. E. Luey, and I. R. Adelman.
Transactions of the American Fisheries Society, Vol 109, No 3, p 332-335, May, 1980. 1 Fig, 1 Tab, 8 Ref.

Descriptors: *Downstream, *Agricultural watersheds, Benthic environment, Watersheds, Tile drainage, Channeling, *Fish, *Ecological effects.

The purpose of this study was to describe general differences between ichthyofaunas in downstream natural areas of drainage-development streams and undeveloped streams, and to determine whether any observed differences might have resulted from long-term effects of previous alteration of upstream areas. Three streams in southwestern Minnesota were studied. Two were relatively unaltered streams, the Cottonwood River and Highwater Creek. The other was a drainage-developed stream, Fort Ridgely Creek. Agricultural drainage development in this area of the country involves the installation of tiles to drain subsurface waters, the creation of tributary ditches, and channelization of existing streambeds. The presence, abundance, and diversity of fishes collected in downstream unmodified areas of drainage-developed and undeveloped streams indicates that any downstream impacts are much less severe than impacts demonstrated by other studies within developed areas. Such natural areas in developing regions appear to serve as reservoirs for stream biotas and should be preserved as refuges for fish species inhabiting those streams. (Baker-FRC)
W81-05927

**TIDAL BARRAGES: BOON OR BLIGHT,**
G. R. Taylor.
Ecologist, Vol 10, No 5, p 167-169, June, 1980. 1 Ref.

Descriptors: *Tidal energy, *Tidal powerplants, *Energy sources, Ecological effects, Economic aspects, Environmental effects, Sediments, Aquatic life, Powerplants.

The possibility of using tidal forces for the generation of electrical energy has been considered for several decades. Tidal barrage schemes have been proposed for a number of estuaries in Great Britain, as well as for numerous sites around the world. One of the most ambitious schemes is that proposed for the barrage on the River Severn in Great Britain, first proposed in 1935. While there have been several proposals for Severn barrages, the one considered most workable involves a barrage 15 kilometers in length and impounding 120 square kilometers of water. While most barrages planned in other parts of the world involve areas having low population, the Severn scheme involves a highly populated area. Potential biological impacts of the barrage include increased tidal range outside the barrage, silting and odors resulting from sediments which are not resuspended, increased coliform counts, and recycling of heavy metals into the water column. The proposed barrage can be expected to have detrimental effects on the existence of salt marshes, waders and waterfowl, salt-tolerant species, and migratory fish and eels. These effects would be especially severe during the 15 to 20 years anticipated for construction of the facilities and during any subsequent shut-downs. An extensive lock system would have to be constructed to accommodate the passage of ships, which would also be disrupted during construction. Using smaller scale barrages on only part of the estuary or using river mills rather than turbines might provide more workable and less ecologically menacing alternatives than vast schemes. (Carroll-FRC)
W81-05939

**EGYPT--AFTER THE ASWAN DAM,**
S. Walton.
Environment, Vol 23, No 4, p 30-36, May, 1981. 22 Ref.

Descriptors: *Ecological effects, *Dams, *Human diseases, *Aswan High Dam, *Egypt, Plant growth, Social impact, Nubians, Public health, Water supply development, Diseases, Infection, Schistosomiasis, Snails, Environmental effects, Erosion, Water table rise, Irrigation, Hydroelectric power, Flood control, Water storage, Siltation, Drainage, Lake Nasser, Lakes.

The environmental effects of the Aswan High Dam are being evaluated by an interdisciplinary group which began work in 1975. Incidence of schistosomiasis, expected to rise to 60% at the dam's completion, instead continued its 40-year decline. Surveys showed that, even in villages with long histories of severe schistosomiasis, incidence averaged 42%. In other areas prevalence was 27% (Upper Middle Egypt) and 4.1% (Upper Egypt, Aswan governate). Likewise, hookworm and roundworm declined, probably because fewer villagers are exposed to the irrigation canals and unsanitary water supplies. Entamoeba infections remain common. Although the Nubians suffered severe culture shock, from the inundation, their rate of infection from water-borne parasites decreased. Flood control, water storage, an additional 2.5 million acres of year-round irrigated farmland, and hydroelectric power are some of the dam's positive effects. On the negative side are salt buildup in the soil, shoreline erosion, raising the water table, excessive water plant growth downstream from the dam, a threat of disease if sanitary water supplies fail, damage to ancient monuments, and destruction of the sardine industry. Management of these problems by erosion control, drainage in irrigated areas, and pollution control are necessary so that unwanted side effects do not cancel out the benefits. (Cassar-FRC)
W81-05949

**WATER - THE SINE QUA NON OF LIFE,**
University Clinic for Infectious Diseases, Copenhagen (Denmark).
For primary bibliographic entry see Field 6D.
W81-06038

**THE DESERT BLOOMS - AT A PRICE,**
D. Sheridan.
Environment, Vol 23, No 3, p 6-20, 38-41, 1981. 2 Fig, 1 Tab, 130 Ref.

Descriptors: *Groundwater depletion, *Arid-zone hydrology, *Water demand, *Economic aspects, Groundwater management, Water supply development, Wells, Saline water intrusion, Irrigation water, Soil erosion, Water reuse, Drought, Aquifers, Water supply, Water shortage, Water conservation.

In this second article of a two part series on the economic and environmental effects of water use in the arid lands of the western United States, four

specific areas of the arid West are examined. The Wellton-Mohawk Irrigation District in southwestern Arizona, the San Joaquin Basin of California, the Santa Cruz Basin of south central Arizona, and Gaines County, Texas are characteristic of human systems that are exceeding their carrying capacity in terms of water demand. The Santa Cruz River, which supplies the city of Tucson, is slowly drying out. The city has purchased numerous irrigation wells and has begun to use recycled water for some municipal projects. The upper Santa Cruz Basin supplies water for the country's largest copper mining complexes. Projects to divert Colorado River water to this area will cost taxpayers an enormous sum of money. Problems of soil erosion due to drought in Gaines County are discussed. Other topics investigated include the Ogallala aquifer, the salinization of croplands, drainage disposal of the San Joaquin Valley, and the feasibility of conservation projects. The dilemma of who should pay for large scale projects still exists. Other problems considered include overgrazing, soil erosion, the impacts of recreation and urbanization, and the rapid depletion of groundwater. The high salinity of the Wellton-Mohawk's drainage wells that discharge into the Colorado River continues to cause problems. A desalination plant has been proposed to handle this situation. (Geiger-FRC)
W81-06043

# 7. RESOURCES DATA

## 7B. Data Acquisition

**WATER QUALITY SIMULATION IN WAHIAWA RESERVOIR, O'AHU, HAWAI'I,**
Hawaii Univ., Honolulu. Water Resources Research Center.
S. F. Moore, G. S. Lowry, G. P. Young, and R. H. F. Young.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-108499, Price codes: A04 in paper copy, A01 in microfiche. Technical Memorandum Report No 64, March, 1981. 50 p, 13 Fig, 3 Tab, OWRT-A-085-HI(1), 14-34-0001-0113, -1113.

Descriptors: *Water resources management, Multiple purpose reservoirs, *Water quality, Simulation analysis, *Hawaii, *Model studies, *River reservoir systems, Dissolved oxygen, Water temperature, Water level fluctuations, *WQRRS model, Wahiawa Reservoir, Oahu.

To assist decision makers in selecting alternative water quality management strategies, the Water Quality for River-Reservoir Systems (WQRRS) model developed for the U.S. Army Corps of Engineers was applied to the multiple-use, Wahiawa Reservoir, which has historically experienced water quality problems--especially low dissolved oxygen (DO) concentrations. The WQRRS model was calibrated and verified to adequately represent dynamic behavior of vertical profiles of water temperature and DO. Although statistical analysis of calibration results showed no significant difference (at a .05 significance level) between observed and simulated water temperatures and DO, simulated temperatures showed a consistent positive bias of about 2C, and simulated DO results corresponded well with observed values during the critical low-flow, summer and fall period. Hydraulic representation of the reservoir was questionable, as demonstrated by differences between simulated and observed water surface elevations. Temperature and DO results were statistically and significantly different from observed values. Observed data showed more thermal stratification in the reservoir than was predicted by the model, which tended to overpredict surface DO values but corresponded well with measured deeper water values. Three preliminary, specific alternative strategies were simulated, but simulation results suggest that none of the strategies by themselves were sufficient to eliminate anaerobic conditions in the reservoir. Principal recommendations are to refine model calibrations, modify the model for artificial aeration simulation, and investigate other management strategies (artificial aeration, combined management strategies).
W81-05705

**EFFECTS OF FLUCTUATING, SUBLETHAL APPLICATIONS OF HEAVY METAL SOLUTIONS UPON THE GILL VENTILATORY RESPONSE OF BLUEGILLS (LEPOMIS MACROCHIRUS),**
Virginia Polytechnic Inst. and State Univ., Blacksburg. Center for Environmental Studies.
For primary bibliographic entry see Field 5C.
W81-05770

**INTEGRATED CONTROL OF COMBINED SEWER REGULATORS USING WEATHER RADAR,**
American Society of Civil Engineers, New York. Urban Water Resources Research Council.
For primary bibliographic entry see Field 5G.
W81-05771

**REOTE MONITORING OF ORGANIC CARBON IN SURFACE WATERS,**
Environmental Monitoring Systems Lab., Las Vegas, NY.
M. Bristow, and D. Nielsen.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-168965, Price codes: A05 in paper copy, A01 in microfiche. Project Summary EPA-600/S4-81-001, April, 1981. 6 p, 4 Fig.

Descriptors: *Remote sensing, *Monitoring, *wAter pollution, *Pollutants, *Organic carbon, Ultraviolet radiation, Fluorescence, Hydrocarbons, Water pollution sources, Data acquisisiton.

Results of this laboratory feasibility study show that the intensity of the Raman normalized fluorescence emission induced in surface waters by ultraviolet (UV) radiation can be used to provide a unique airborne remote sensing capability for monitoring the concentration of dissolved organic carbon (DOC). Trace concentrations of hydrocarbons, both man-made and natural in origin, are the predominant source for this fluorescence. Water, on the other hand, is nonfluorescent under UV irradiation, but emits an intense Raman band of constant amplitude relative to the incident light. This Raman emission can be used as an internal reference or normalizing standard with which to correct the fluorescence emission for the effects of attenuation, for variations in system sensitivity, and for changes in sensor elevation. It is recommended that a direct calibration of the airborne fluorescence data in terms of equivalent DOC concentration be accomplished by making DOC measurements on samples obtained at a small numer of reference sites under the aircraft flight path at the time of the airborne survey. Airborne laser fluorosensors that utilize this principle will provide a synoptic survey capability for rapidly and cost effectively producing isopleth maps that show concentrations of surface water DOC. These concentrations can be used for delineating gradients, temporal changes and anomalies in the distribution of total dissolved organics in the surface layers of rivers, lakes and coastal waters. anomalous features in the airborne data that cannot be readily explained on the basis of existing information can then be investigated in more detail either by means of in situ monitoring or by laboratory analyses of grab samples. Specific applications will include collcting baseline data, verifying lake cleanup and resotration, designing sampling netowrks, modeling ecosystems and locating point and nonpoint sources of unknown origin. (Brambley-SRC)
W81-05773

**AUTOMATED SYSTEM FOR COLLECTING SNOW AND RELATED HYDROLOGICAL DATA IN MOUNTAINS OF THE WESTERN UNITED STATES,**
Soil Conservation Service, Washington, DC. Engineering Div.
R. E. Rallison.
Hydrological Sciences Bulletin, Vol 26, No 1, p 83-89, March, 1981. 4 Ref.

Descriptors: *Data transmission, *Snow surveys, *Telemetry, Snow, Snow accumulation, Snowmelt, Potential water supply, Automation, Mountains, Remote sensing.

An automated data collection system called SNOTEL (for snow telemetry) is being installed in the western US to collect snow and related bhydrolgical data. Snowmelt runoff contributes about 75% of the water supply in this area, and this type of data has been collected manually for about 40 years. At each SNOTEL site there will be sensors ro measure snow water content, accumulated precipitation, and temperature. These automated snesors will eliminate the need for manual measurements at more than 500 of the 1600 data sites in the snow information network. Meteor trails are used to transmit data from remote sites to a master station. This real time system is capable of collecting and transmitting data from as many as 1000 remote sites and from as many as 16 digital or analog sensors at each site. A performance test held in February 1979 was successful. By November 1980, a total of 475 remote stations will be in full operation which will complete the planned system for all states except Alaska. (Small-FRC)
W81-05833

**INSTRUMENTATION AND MONITORING OF EXCAVATIONS,**
Parsons, Brinckerhoff, Quade and Douglas, Inc., Boston, MA.
H. A. Russell.
Bulletin of the Association of Engineering Geologists, Vol 18, No 1, p 91-99, 1981. 11 Fig, 4 Ref.

Descriptors: *Excavations, *Measuring instruments, *Soil engineering, Safety, Engineering, Dams, Soil mechanics, Monitoring, Deformation, Tunnels, Gages, Strain gages, Surveying instruments, Extensometers, Soil moisture meters, Piezometers, On-site tests.

Use of instruments for measuring soil movements can contribute to construction cost savings and safety. To measure vertical movement, the Invar rod, two-section Philadelphia Survey rod, extensometer, tiltmeters, or Sondex system may be utilized. Horizontal movements are monitored with survey equipment such as the transit/theodolite or inclinometer and many of the instruments used for vertical measurements. Deformations may be measured with the extensometer or strain gages and earth pressure cells. Pore pressure measurements are performed by three types of piezometers; electric vibrating (good for offset locations), hydraulic (preferably the double tube Casagrande type), and pneumatic. A less sophisticated method of measuring groundwater uses the depth of water in a simple standpipe. The methods described are very accurate. The surveying instruments read to the thousandths per foot; the tiltmeter, +- ten seconds of arc; Sondex system, 0.05 per inch; and inclinometer, 0.005 per ft. (Cassar-FRC)
W81-05860

**A MICROPROCESSOR AUTOMATED RILLMETER,**
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Center.
J. K. Radke, M. A. Otterby, R. A. Young, and C. A. Onstad.
Transactions of the ASAE, Vol 24, No 2, p 401-404, 408, March/April, 1981. 6 Fig, 18 Ref.

Descriptors: *Soil surfaces, *Measuring instruments, *Rills, *Erosion, Computers, Field tests, Rillmeter.

A rillmeter was designed to meet the following requirements: measure 300 or more surface elevations in less than a minute, have a vertical resolution of 1 mm over a 25 cm range, be suitable for field use, and automatically record data on an easily accessible medium. The rillmeter measures 312 surface elevations with sensing rods arranged in 3 rows of 104 rods each. It uses a 12-volt DC electric motor and a positive mechanical drive to lower a movable platform containing a grid of

sensing rods that open individual electrical contacts upon touching the soil surface. A microprocessor scans the contacts and stores the information in memory. After all the data is stored, it is transferred to magnetic cassette tape. Field tests showed that the rillmeter met specifications. Soft soil requires larger sensing pads on the bottom of the rods. Sensing switches need frequent cleaning and adjustment for reliable operation. (Cassar-FRC)
W81-05865

**'MAP SKEW'. (DISCUSSION),**
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2E.
W81-05884

**COLLAPSIBLE-BAG SUSPENDED-SEDIMENT SAMPLER,**
Geological Survey, Lakewood, CO. Water Resources Div.
H. H. Stevens Jr., G. A. Lutz, and D. W. Hubbell.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 611-616, April, 1980. 2 Fig, 5 Ref.

Descriptors: *Suspended sediment, *Sampling, *Sediment sampler, Estuaries, Rivers, Water depth, Performance evaluation.

Sampling characteristics of two sizes of bag samplers were evaluated in the Columbia River, and experiments with a two-gallon bag sampler were performed in a flume at St. Anthony Falls Hydraulic Laboratory, Minneapolis, Minnesota. With a straight bore nozzle, the intake sampling velocities were somewhat lower than comparable stream velocities; with a tapered nozzle, intake velocities approximately equaled stream velocities. The collapsible-bag sampler is ideal for use in large rivers and estuaries because it continuously collected representative depth-integrated samples of water-sediment mixture. The maximum depth capacity of the sampler can be readily changed by altering the internal diameter of the nozzle or the volume of the sample bag. It is easy to use and maintain even in salt water. When the sounding weight is placed below the sampler, the required stability is provided, but the distance between the nozzle and the effective bottom of the sampler is greater than the distance on conventional depth-integrating samplers. Thus, the unsampled depth is unusually large. New samplers could be designed which would incorporate all of the required weight within the sampler body. (Small-FRC)
W81-05904

**THE PREDICTION OF RIVER WATER TEMPERATURES,**
University of Strathclyde, Glasgow (Scotland). Dept. of Geography.
K. Smith.
Hydrological Sciences Bulletin, Vol 26, No 1, p 19-32, March, 1981. 7 Fig, 9 Tab, 19 Ref.

Descriptors: *Mathematical models, *Water temperature, *Rivers, Temperature effects, Thermal pollution, Mathematical equations, Graphical analysis, Prediction.

Two methods are described which are suitable for use by water managers in predicting river temperatures on an operational basis over a wide range of time scales. For the first method, simple linear equations are presented for estimates annual and monthly river temperatures using air temperature alone. For the second method, it is shown how an empirical equation can be fitted to short term observations of river temperatures in order to represent seasonal and diurnal cycles. These methods can also be used to assess the extent of any thermal modification. if suitable air or water temperature data are available, the effects of construction of, for example, a new storage reservoir on a river could be evaluated. The reservoir would be expected to cause a reduction in both mean temperature and the range of variation, which would result in a lower correlation coefficient with air temperature. Using the second method for this example, the expected reduction in mean temperature and amplitude, combined with an increase in the absolute value of the phase coefficient, would be apparent from the fitted sine curves on either a seasonal or a daily time scale. (Small-FRC)
W81-05924

**MEASUREMENT OF WATER POTENTIAL USING THERMOCOUPLE HYGROMETERS,**
Natal Univ., Pietermaritzburg (South Africa). Dept. of Soil Science and Agrometeorology.
M. J. Savage, A. Cass, and J. M. de Jager.
South African Journal of Science, Vol 77, No 1, p 24-27, January, 1981. 6 Fig, 35 Ref.

Descriptors: *Water potentials, *Hygrometry, *Dewpoint, Soil moisture, Temperature, Measuring instruments.

Water potential measurement may be improved by calibration of the instruments. In theory, the time dependent voltage curve of a psychrometer where there is no change in voltage with time defines the wet bulb temperature. In practice, a change in voltage with time does occur, and it is convenient to define the voltage corresponding to the water potential as the maximum point-of-inflection voltage. If an accuracy of + or - 5% in water potential measurement is desired, a given psychrometer should be calibrated at several temperatures. The dewpoint hygrometer has the advantage that the voltage is more sensitive to water potential and less sensitive to temperature. The dewpoint cooling coefficient should be predetermined for each hygrometer as a function of temperature. (Cassar-FRC)
W81-05940

**GROUND WATER IN DIAGENETICALLY CONSOLIDATED ROCKS AND ITS INDIRECT RECONNAISSANCE BY AIRPHOTO LINEAR ANALYSIS,**
Mainz Univ. (Germany, F.R.). Inst. fuer Geowissenschaften.
M. Furst.
Aqua, No 5, p 107-112, 1980. 15 Fig, 24 Ref.

Descriptors: *Groundwater movement, *Borehole geophysics, *Aerial photography, Groundwater storage, Geophysics, Water supply development, Groundwater mining, Water supply, Photography, Drainage patterns.

A simple method of indirectly detecting joint water bearing zones in solid rock by photogeological linear analysis is described. The analysis consists of two steps, the first of which involves the description of gray tone and vegetation interchanges, drainage and morphologic linears on air pictures. In the second step, block synthesis is utilized to elaborate blocks of a greater order. The Lyppstadt, Bad Muestereifel, and Bad Kreuznach areas of West Germany were examined by this technique for additional supplies of groundwater. Flow meter data and other geophysical well logging measurements show that ground water supplies explored within diagenetically consolidated rocks enter boreholes mainly through joint and fracture systems. These findings illustrate the direct relation between drilled fractures and mapped linears. (Geiger-FRC)
W81-05945

**LOW-VELOCITY WATER TUNNEL FOR BIOLOGICAL RESEARCH,**
California Univ., Santa Barbara.
A. C. Charters, and S. M. Anderson.
Journal of Hydronautics, Vol 14, No 1, p 3-4, January, 1980. 3 Fig.

Descriptors: *Hydrodynamics, *Uniform flow, *Oceanography, Tunnels, Laboratory equipment, Model studies, Turbulence, Flow characteristics, Aquatic plants, Simulation analysis.

A water tunnel, costing less than $10,000, was designed to represent oceanic conditions. This apparatus provides a very smooth, uniform flow from 3 to 30 cm per sec in a working section 10 cm diameter by 100 cm length. It is suitable for research on hydrodynamics of marine botany, including macroalgae. The desired low-velocity, low-turbulence conditions were attained with a centrifugal pump in a gravity system operating at a constant head greater than the minimum required head of 0.5 cm. Surges are eliminated by returning the flow to the reservoir partly through the working section and partly through the overflow return line. Turbulence is minimized by diffusors, baffles, honeycombs, and screens. Dye tests allowed visual observations of the low turbulence, measured at less than 1%. (Cassar-FRC)
W81-05959

## 7C. Evaluation, Processing and Publication

**SURFICIAL GEOLOGY OF MALLORY QUADRANGLE, OSWEGO COUNTY, NEW YORK,**
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, paper copy $2.50, microfiche $2.50. Geological Survey Open-File Report 81-336 (WRI), 1981. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, Geohydrology, Wells, Water yield, Maps, *New York, Oswego County, Mallory quadrangle.

The location and extent of seven kinds of surficial deposits in Mallory quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the lithology and poential for groundwater development at any specific location. (USGS)
W81-05707

**SHALLOW GROUND-WATER CONDITIONS AND VEGETATION CLASSIFICATION, CENTRAL VOLUSIA COUNTY, FLORIDA,**
Geological survey, Tallahassee, FL. Water Resources Div.
E. P. Simonds, Jr., B. F. McPherson, and P. W. Bush.
Geological Survey Open-File Report 80-752 (WRI), 1980. 1 Sheet, 12 Fig, 1 Tab, 10 Ref.

Descriptors: *Maps, *Grlundwater, *Vegetation, *Wetlands, Water level fluctuations, Aquifers, Shallow wells, Recharge, Wells, Rainfall, Land use, Hydrographs, *Florida, *Volusia County, Vegetation classification.

The existing vegetation and water-level fluctuations for the major vegetative classes have been documented for a wetland area in central Volusia County, Fla. The area, 140 square miles in size, is a potential recharge area. Seventeen land-use classifications modified from Anderson and others (U.S. Geological Survey Professional Paper 964, 1976) by the State of florida were used to describe the existing vegetation. Shallow wells were placed in the major vetgetative classes: (1) cypress forest, (2) plant pine forest, (3) pine flatwoods, (4) sand pine scrub, (5) rangeland. With the use of long-term rainfall data (30 years), 13 years of lake elevations from Lake Winona, and 1 year of water levels from the 5 wells, a general range of water-level fluctuations was determined for the major land-use classifications. (USGS)
W81-05709

**DRAINAGE AREAS OF SELECTED SURFACE-WATER SITES IN FLORIDA,**
Geological Survey, Tallahassee, FL Water Resources Div.
D. W. Foose.
Available from the OFSS, USGS Box 25425, Fed. Ctr., Denver, CO 80225, Price: $11.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-481, 1981. 83 p, 1 Fig, 3 Tab, 3 Ref.

Descriptors: *Drainage area, *Surface water, *Hydrologic data, Gaging stations, Sites, Lakes, Streams, *Florida, Sites.

Drainage areas for about 1,600 surface-water sites on streams and lakes in Florida are contained in this report. The sites are generally either U.S. Geological Survey gaging stations or the mouths of gaged streas. Each site is identified by latitude and longitude, by the general stream type, and by the U.S. Geological Survey 7.5-minute topographic map on which it can be located. The gaging stations are furhter identified by a downstream order number, a county code, and a nearby city or town. In addition to drainage areas, the surface areas of lakes are shown for the elevation given on the topographic map. These data were retrieved from the Surface Water Index developed and maintained by the Hydrologic Surveillance section of the Florida District Office, U.S. Geological Survey. (USGS)
W81-05710

**EVALUATION OF WATER RESOURCES IN THE REEDSPORT AREA, OREGON,**
Geological Survey, Portland, OR. Water Resources Div.
J. F. Rinella, F. J. Frank, and A. R. Leonard.
Geological Survey Open-File Report 80-444 (WRI), 1980. 37 p, 4 Fig, 1 Plate, 13 Tab, 23 Ref.

Descriptors: *Evaluation, *Water supply, *Oregon, Lake morphometry, Municipal water, Sand, Aquifer characteristics, Groundwater, Evaporation, Precipitation, Runoff, Natural recharge, Water yield, Hydrologic budget, *Water quality, Water analysis, Chemical analysis, Reedsport, Clear Lake.

The water supply for the Reedsport area is obtained from Clear Lake, a 310-acre coastal lake that contains 16, 600 acre-feet of water at full-pool. The lake receives about 6,000 acre-feet of water annually from runoff and direct precipitation, and it loses about 600 acre-feet by evaporation. The 2,100 acre-feet diverted annually for public supply is about two-thirds of the 'usable storage capacity' of the lake volume above the water-supply outlet pipe. Clear Lake is classified as a warm monomictic lake; that is, it is thermally stratified except during winter. The water of Clear Lake is of the sodium chloride type and is low in dissolved solids and nutrients. The water is considered to be of good quality for public supply, on the basis of biological and chemical constituents analyzed, which include trace elements pesticides, and organic material. The only ground-water source with potential to supply the needs of the Reedsport area is the dune sand-marine aquifer between U.S. Highway 101 and the coast. That aquifer consists largely of medium- to fine-grained sand with a variable saturated thickness of at least 90 feet. The aquifer is estimated to contain at least 12 billion gallons of water and to receive annual recharge from precipitation equivalent to 10 million gallons per day. Wells in the most productive part of the aquifer could be expected to yield a few hundred gallons per minute. The only identified water-quality problem is excessive iron reported in water from some wells. Either Clear Lake or the major aquifer could supply the Reedsport area's aticipated year 2000 need of about 2.4 million gallons per day. (USGS)
W81-05716

**FLOOD OF APRIL 13, 1980, MOBILE, ALABAMA,**
Geological Survey, Louisville, KY. Water Resoaurces Div.
For primary bibliographic entry see Field 2E.
W81-05717

**GROUND-WATER AVAILABILITY AND WATER QUALITY IN FRAMINGTON, CONNECTICUT,**
Geological Survey, Hartford, CT. Water Resources Div.
D. L. Mazzaferro.
Geological Survey Open-file Report 80-751, 1980. 57p, 6 Fig, 7 Plates, 15 Tab, 23 Ref.

Descriptors: *Groundwater availability, *Water quality, Aquifers, *Water supply, *Connecticut, Water resources development, Data collections, Hydrologic cycle, Water yield, Aquifer characteristics, Observation wells, Water level, Groundwater movement, Groundwater potential, Mathematical models, Water analysis, *Farmington River.

The stratified-drift aquifer in Farmington, Conn., is capable of yielding large amounts of water to individual wells. About 14 square miles of Farmington is underlain by stratified-drift deposits which, in places, are more than 450 feet thick. The most productive deposits are found in the Farmington River valley, from Unionville to River Glen, and along Scott Swamp Brook. In these areas, saturated, coarse-grained, stratified-drift deosits exceed 80 feet in thickness and estimated yields to individual wells ranged from 250 to 1,000 gallons per minute. Results of mathematical model analysis of three of the most favorable groundwater areas indicate that long-term yields range from 1.2 to 2.5 million gallons per day. Water in the Framington and Pequabuck Rivers meets the Connecticut Drinking Water Standards, assuming complete conventional treatment, for coliform orgaisms, color, trubidity, chloride, copper, and nitrate. Coliform bacteria concentrations in the Pequabuck river (12-month geometric mean of about 6,800 colonies per 100 milliliters of water) indicate a potential problem. Water in the stratified-drift aquifer is of good quality with the exception of manganese; 10 of 11 wells sampled had maganese concentrations above 0.05 milligram per liter. (USGS)
W81-05718

**GROUND-WATER LEVELS IN ALABAMA, FOR OBSERVATION WELLS MEASURED PERIODICALLY AUGUST 1952 THROUGH JULY 1977,**
Geological Survey, University, AL. Water Resources Div.
For primary bibliographic entry see Field 2F.
W81-05720

**WATER RESOURCES DATA FOR GEORGIA, WATER YEAR 1980,**
Geological Survey, Doraville, GA. Water Resources Div.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-245250, Price codes: A20 in paper copy, A01 in microfiche.
Geological Survey Water-Data Repot GA-80-1, June, 1981. 455 p, 9 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, gaging stations, streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Georgia.

Water resources data for the 1980 water year for Georgia consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and ground-water levels. This report contains discharge records for 105 gaging stations; stage for 9 gaging stations; stage and contents for 17 lakes and reservoirs; water quality for 22 continuous stations, 129 periodic stations and miscellaneous sites; peak stage and discharge only for 109 crest-stage partial-record stations and 15 miscellaneous sites; measurements of discharge at 108 low-flow partial-record stations and 69 miscellaneous sites; and water levels for 28 observation wells. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in Georgia. (USGS)
W81-05721

**WATER RESOURCES DATA FOR MICHIGAN, WATER YEAR 1980,**
Geological Survey, Lansing, MI. Water Resources Div.
Geological Survey Water-Data Report MI-80-1, 1981. 649 p, 9 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamflow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Michigan.

Water resources data for the 1980 water year for Michigan consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water lvels, water quality, and water temperature of ground-water wells. This report contains discharge records for 180 gaging stations, stage only records for 4 gaging stations, stage and contents for 5 lakes and reservoirs, water quality for 62 continuous-record stations, and water levels for 52 observation wells. Also included are 87 crest-stage partial-record stations and 62 low-flow partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. These data represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Michigan. (USGS)
W81-05722

**WATER RESOURCES DATA FOR MASSACHUSETTS AND RHODE ISLAND, WATER YEAR 1980,**
Geological Survey Boston, MA. Water Resources Div.
Geological Survey Water-Data Report MA-RI-80-1, May, 1981. 348 p, 5 Fig.

Descriptors: *Hydrologic data, *Surface water, *Groundwater, *Water quality, Gaging stations, Streamfow, Flow rates, Sediment transport, Water analysis, Water temperature, Chemical analysis, Lakes, Reservoirs, Wells, Water level, Data collections, Sites, *Massachusetts, *Rhode Island.

Water-resources data for the 1980 water year for Massachusetts and Rhode Island consist of records of stage, discharge, and water quality of streams; contents of lakes and reservoirs; and ground-water levels. This report contains discharge records for 102 gaging stations, monthend contents for 30 lakes and reservoirs, water quality for 24 gaging stations, and water levels for 108 observation wells. Also included are data for 20 low-flow and 19 crest-stage partial-record stations. Additional water data were collected at various sites, not part of the systematic data-collection program, and are published as miscellaneous measurements. A few pertinent stations (not included above) in bordering States are also included in this report. These data represent that potion of the National Water Data System operated by the U.S. Geological Survey and cooperating State and Federal agencies in Massachusetts and Rhode Island. (USGS)
W81-05723

**ESTIMATED PUMPAGE FROM GROUNDWATER SOURCES FOR PUBLIC SUPPLY AND RURAL DOMESTIC USE IN FLORIDA, 1977,**
Geological Survey, Tallahassee, FL. Water Resources Div.
H. G. Healy.
Florida Bureau of Geology Map Series No 102, 1981. 1 Sheet, 1 Fig, 1 Tab, 20 Ref.

Descriptors: *Groundwater, *Pumpage, *Aquifers, *Water use, Water supply, Domestic water, Rural areas, Hydrologic data, *Florida, Groundwater availability.

In 1977, ground water from 4 principal aquifers supplied 86 percent of the total quantity of water required for public supply in Florida. The Floridan aquifer supplied 459, the Biscayne aquifer 461, the sand-and-gravel aquifer 34, and 'other' aquifers 105 million gallons per day. This report documents the quantities of ground water withdrawn for public supply and rural domestic use, identifies the aquifers that are sources of supply, and presents trends of pumpage from 1965 through 1977. During this 13-year period, statewide groundwater use has increased 65 percent for public supply and 60 percent for rural domestic use. For the same interval, pumpage for public supply from the Floridan aquifer increased 62 percent, from the

Biscayne 68 percent, from the sand-and-gravel 79 percent, and from 'other' aquifers 100 percent. (USGS)
W81-05724

**PRELIMINARY INVESTIGATION OF A SHALLOW GROUND-WATER FLOW SYSTEM ASSOCIATED WITH CONNETQUOT BROOK, LONG ISLAND, NEW YORK,**
Geological Survey, Syosset, NY. Water Resources Div.
For primary bibliographic entry see Field 5F.
W81-05727

**GEOLOGY AND HYDROLOGY FOR ENVIRONMENTAL PLANNING IN MARQUETTE COUNTY, MICHIGAN,**
Geological Survey, Lansing, MI. Water Resources Div.
F. R. Twenter.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-221467, Price codes: A04 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-90, 1981. 44 p, 16 Fig, 5 Tab, 21 Ref.

Descriptors: *Environment, *Planning, *Geology, *Water supply, Water quality, Surface water, Groundwater, *Aquifer characteristics, Waste disposal, *Michigan, Marquette County.

Marquette County, in the glaciated area of the Upper Peninsula of Michigan, includes 1,878 square miles. Precipitation averages 32 inches per year. Bedrock and glacial deposits contain materials that are good aquifers. Sedimentary bedrock units generally yield sufficient water for domestic supply and, in places, may yield more than 100 gallons per minute to large-diameter wells. In the glacial deposits, sand and gravel beds are the principal aquifers; yields to wells range from less than 10 to 200 gallons per minute. Igneous and metamorphic rocks yield little or no water to wells. Suitable sewage and refuse disposal sites are not readily available because of the abundance of wetlands, streams, and lakes susceptible to infiltrating leachate. (USGS)
W81-05732

**WATER-LEVEL DATA FOR WELLS IN AND NEAR BURIAL GROUND 4, OAK RIDGE NATIONAL LABORATORY, TENNESSEE, 1975-1979,**
Geological Survey, Knoxville, TN. Water Resources Div.
D. A. Webster, J. S. Beatty, P. M. Benjamin, and W. M. Tranum.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-339, 1981. 52 p, 1 Plate, 2 Tab, 3 Ref.

Descriptors: *Data collections, *Observation wells, *Water level, *Radioactive waste disposal, Hydrographs, Maps, Sites, Water level fluctuations, Water measurement, *Tennessee, *Oak Ridge National Laboratory.

Data pertaining to wells in and near Burial Ground 4 (radioactive waste) at Oak Ridge National Laboratory, Tennessee is presented for the period 1975-1979. An inventory of wells, measurements of water levels, well hydrographs, and a map showing the location of the wells, are included. (USGS)
W81-05734

**WATER-LEVEL CONTOURS NEAR LA GRANGE, SOUTHEASTERN WYOMING AND AN ADJACENT PART OF NEBRASKA, APRIL 30, 1980,**
Geological Survey, Cheyenne, WY. Water Resources Div.
W. B. Borchert.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO 80225, Price: $1.75 in paper copy, $0.50 in microfiche. Geological Survey Open-File Map Report 81-422, 1981. 2 Sheets.

Descriptors: *Water level, *Aquifers, *Maps, *Contours, Water measurement, Water wells, Irrigation wells, Springs, Sites, Surface water, *Wyoming, *Nebraska, La Grange.

This map shows water-level contours for the shallow aquifers in the La Grange area of southeastern Wyoming and adjacent Nebraska as of April 30, 1980. Water-level measurements made on April 30, 1980, provided the principal control for most of the area of the map. Measurements made in April 1979 were used as control for some areas that are remote from centers of pumping. The contours are shown at a 20-foot interval on a map scale of 1:48,000. Irrigation wells, other wells where water-level measurements were made, and springs are located on the map along with surface-water features in the area. (USGS)
W81-05739

**WATER QUALITY, ENERGY, AND SOCIOECONOMICS: PATH ANALYSES FOR STUDIES OF CAUSALITY,**
National Center for the Analysis of Energy Systems, Upton, NY.
E. Kaplan, and H. C. Thode Jr.
Water Resources Research, Vol 17, No 3, p 491-503, June, 1981. 8 Fig, 8 Tab, 24 Ref.

Descriptors: *Water quality, *Economic aspects, *Environmental effects, Land use, Social aspects, Statistical analysis, Energy, Streams, Population dynamics, Electric power production, Industrial production, Natural waters.

Water quality data in streams for 65 variables (oxygen-related, bacteria, nutrients, ions, solids, dissolved trace and toxic elements, toxic nonmetals, organics, radionuclides, pesticides, and pH were correlated with energy and socioeconomic data from 138 counties in New England, the Middle Atlantic states, and Ohio. All data was aggregated on a county basis. Some of the conclusions reached were: (1) counties with increased mineral shipments (coal in western Pennsylvania and Ohio) have waters with higher levels of iron, Mn, and sulfate and lower pH; (2) alkalinity, solids, and hardness are higher in counties with high levels of industrial electric consumption and more farming acreage; (3) production of electricity in a county does not significantly affect water quality, (4) water with higher levels of specific conductance and dissolved ions is correlated with higher levels of industrial electric consumption and with higher populations. Factors considered in the analysis were population, employment, farm acreage, value added in farm products, value added in manufacturing, total income, retail sales, mineral shipments, electric consumption (industrial, residential, and commercial), electric production, and total energy production. (Cassar-FRC)
W81-05825

**WRC STANDARD FLOOD FREQUENCY GUIDELINES,**
Susquehanna River Basin Commission, Harrisburg, PA.
For primary bibliographic entry see Field 2E.
W81-05850

**REDUCING HYDROLOGIC PARAMETER UNCERTAINTY,**
Texas Univ. at Austin. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W81-05851

# 8. ENGINEERING WORKS

## 8A. Structures

**PIPE BEDDING AND BACKFILL,**
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
A. K. Howard.
Geotechnical Branch Training Manual No 7, June, 1981. 58 p, 20 Fig, 1 Tab, 1 Append.

Descriptors: *Pipelines, *Pipes, *Backfill, Soil types, Foundation rocks, Trenches, Soil density, Deformation, Water transport, Design criteria.

This manual for constructing bedding and backfill for buried pipe has been developed because of the increasing use of pipelines rather than canals, the use of larger pipe, the availability of new pipes and materials, and problems with installations. A buried pipe is a structure that incorporates both the properties of the pipe and the properties of the soil surrounding the pipe. The installation requirements include the right type of soil and depend on the type of pipe - rigid or flexible - the diameter of the pipe, and the special case of PVC pipe. Specific installation instructions are given on the type and distribution of soil, including the foundation, bedding and backfill, and the achieving of soil-pipe contact. Correct trench dimensions are required for each type of pipe and depend on the type of soil. Density tests are conducted to ensure correct soil density. Elongation and deflection are generally problems of flexible pipes and allowable net deflections have been established. Specific instructions are given for the installation of small diameter pipes (10 in or less) and PVC pipes. (Brambley-SRC)
W81-05741

**LOCKS AND MECHANICAL LIFTS: STATE OF THE ART,**
J. P. Davis.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980, Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 419-441, 10 Fig, 6 Ref.

Descriptors: *Locks, *Waterways, *Hydraulic design, *Navigation, Gates, Design criteria, Hydraulic valves, Model studies, Water conservation.

Since 1978, there has been a steady progress of improvements in design, construction and operation of locks. It is no longer necessary to perform model tests for three sizes of low lift sideport system locks provided the generalized design curves that were developed in the consolidated model testing program are utilized. The bottom longitudinal filling system has been proven to be superior to other types of systems for intermediate lift and high lift locks. Development of the reverse tainter valve and its refinement in the Holt Lock design studies have eliminated most lock valve problems. Better lock gates have been developed. Great improvements in electrical and mechanical equipment, communications equipment and operating and safety equipment have been accomplished since 1930. European lock designs generally are no better, and in some respects are not as good as United States designs. Lock separation, use of impact barriers to protect lock gates, and high lift lock filling system designs from Europe are worthwhile developments. The principal advantage to mechanical lifts used in Europe is the elimination of the need for lockage water, but the capacity of a mechanical lift is much less than a conventional lock. A water saving basin lock can reduce lockage water by a significant percentage, but the filling time is increased by 50 to 100%. (Moore-SRC)
W81-05750

**LIFTABLE AND COLLAPSIBLE BARRAGE,**
Pirelli Furlanis--Applicazioni Idrauliche Agricole Gomma S.p.A., Milan (Italy). (Assignee).
B. Borca, and F. Calza.
U.S. Patent No 4,229,119, 5 p, 3 Fig, 5 Ref; Official Gazette of the United States Patent Office, Vol 999, No 3, p 1063. October 21, 1980.

Descriptors: *Patents, *Dams, *Engineering structures, *Water control, Water level, Canals, *Portable barrage.

This invention relates to a barrage, artificial dam or sluice-gate and the like for waterways such as canals, rivers which can be raised and lowered. It includes a flexible and inextensible sheet bonded water-tight by its own edges to the bottom and banks of the waterway, and with its remaining edge raised some distances from the bottom. It is

characterized by a system of cables fixed to the banks of the canal upstream of the barrage, a system of ties fixed to the banks of the canal downstream of the barrage, and means to vary the length of the series of ties fixed to the banks of the canal upstream of the barrage. The object is to provide a barrage which when lowered does not obstruct the waterway in which it is positioned and allows full and accurate control of the level of water in the basin upstream of the barrage. (Sinha-OEIS)
W81-05785

**WELL-EFFICIENCY PROJECT YIELDS ENERGY-SAVING DATA,**
F. G. Driscoll, D. T. Hanson, and L. Page.
Johnson Driller's Journal, Vol. 53, No. 1, p 11-22, 1981. 4 Fig, 10 Tab.

Descriptors: *Irrigation wells, *Well yield, *Energy, Well screens, Well development, Well drilling, Staples, Minnesota, Pumping tests, Transmissivity, Aquifers, Drilling fluids.

This paper, fourth in a series on a well efficiency project at Staples, Minnesota, demonstrates that proper design and construction of high capacity wells increases efficiency and lowers energy costs. Factors influencing efficiency of these high-yield irrigation wells are drilling mud selection, screen open area, screen slot configuration, development, and gravel pack. Tables list the construction details and performance of 10 experimental wells, some constructed with obvious, common faults and sme designed for maximum performance. Well No. 5 had 89% efficiency, as defined by Mogg, 1968. It has a screen of V-shaped wire, continuous slot 304 stainless steel, and a slot size of 0.075 inches, optimum for geologic conditions. The slot configuration allowed excellent access to the formation and good fine particle removal. The screen open area was 38.9%. Other wells in the field ranged from 26 to 67% efficiency. A table, which divided the U.S. into nine regions, indicates that efficient well designed can save from a low of 0.06 million BTUs in the East to a high of 0.50 million BTUs in the Southwest. (Cassar-FRC)
W81-05883

**RISK ANALYSIS FOR HYDRAULIC DESIGN,**
Texas Univ. at Austin. Dept. of Civil Engineering.
Y-K Tung, and L. W. Mays.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY5, p 893-913, May, 1980. 4 Fig, 29 Ref.

Descriptors: *Hydraulic design, *Risks, *Mathematical models, Hydraulic structures, Economic aspects, Safety, Hydraulic engineering.

Models which can be used to integrate several of the various possible types of uncertainties in order to define risk and reliability for hydraulic structures are described. These static and dynamic risk and reliability models can be used to develop risk-safety relationships for various return periods and expected service lives that can be used in design. Single loading applications are considered by static models, while dynamic models consider repeated application of random loadings to define a composite risk. The models are applied to develop safety-risk curves for culvert design. Uncertainties in hydraulic structure design fall into four classifications: hydrologic, hydraulic, structural, and economic. These models address all four types of risk, not just hydraulic and hydrologic. The use of statistical and probability models cannot circumvent the difficulties in hydraulic design, but such probabilities may be a suitable alternative to the conventional form of expressing engineering judgements. (Small-FRC)
W81-05897

**DAM-BREAK WAVE MODEL: FORMULATION AND VERIFICATION,**
Geological Survey, NSTL Station, MS. Gulf Coast Hydroscience Center.
C-L. Chen, and J. T. Armbruster.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY5, p 747-767, May, 1980. 7 Fig, 21 Ref.

Descriptors: *Dam failure, *Flood waves, *Mathematical models, Flood routing, Computer models, Shock loads, Flow velocity, Laurel Run Dam, Pennsylvania.

Some findings and accomplishments are presented in the field verification of the reconstructed flood wave resulting from the failure of Laurel Run Reservoir Dam near Johnstown, Pennsylvania. The formulation capabilities and limitations of the model used in the study are described. A one-dimensional dam-break flood routing model was developed which incorporates the shock equations with characteristic equations used to solve the flow depths and velocities at the advancing shock front. The model was modified by introducing the storage width in the equation of continuity and conceptual conveyance width in the equation of motion. This overcomes the computational difficulty at the narrow dam breach and at any location where channel geometry changes rapidly. The Laurel Run Dam flood wave was simulated and the simulation was compared with field data. There was close agreement between observed and computed peak stages, which suggests that the model is valid for routing a dam-break flood wave in a nonprismatic channel. (Small-FRC)
W81-05903

## 8B. Hydraulics

**NAVIGATION HYDRAULICS,**
L. L. Daggett.
In: National Waterways Roundtable Proceedings, Norfolk, Virginia, April 22-24, 1980. Army Engineer Water Resources Support Center, Institute for Water Resources Report IWR-80-1, 1980. p 407-418.

Descriptors: *Waterways, *Navigation, *Dams, *Locks, *Hydraulic design, Sediments, Channel improvement, Channel morphology, Erosion, Hydroelectric plants, Turbulence, Hydraulic engineering.

The hydraulic engineering aspects of navigation can be categorized into three broad areas: locks and dams; channel dimensions and alignment; and channel stability and development. In raising or lowering vessels from one navigation pool to the next, locks require a certain amount of time to service a vessel, and can potentially create a queuing situation with the resulting delays to traffic. The time required to service vessels is largely dependent on the hydraulic characteristics at the lock, both in the channels adjacent to the lock and of the lock filling and emptying system. While lock dimension may be governed by factors other than hydraulics, significant physical effects influence the locking process due to the relative size of the lock and the vessel entering and exiting the lock. Hydraulic model studies have been used extensively in modifying and designing navigational facilities and have proven to be very effective in determining the conditions affecting navigation. Hydropower plants can seriously affect conditions in the lower lock approach by surges and currents caused by water releases. The design of channels must take into account the maneuvering characteristics of the vessels using the channel, the relative dimensions of the vessels and channel, the human element, the alignment of the banks, currents, the flow field, and fluctuations in flow. Most waterways are located in natural streams, many of which carry heavy sediment loads. Such streams are highly dynamic in nature and tend to meander and migrate. Shoaling problems affecting channel width, depth, and alignment can be encountered in any stream carrying sediment, and concern has developed over the stability of channel banks. (Moore-SRC)
W81-05749

**CAVITATION INDUCED BY TURBULENCE IN STILLING BASIN,**
University of Manchester Inst. of Science and Technology (England). Dept. of Civil and Structural Engineering.
R. Narayanan.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY4, p 616-619, April, 1980. 2 Fig, 6 Ref.

Descriptors: *Stilling basins, *Turbulent flow, *Cavitation, Fluid mechanics, Flow, Dam design, Hydraulic jump, Velocity, Froude number.

In stilling basins, intense turbulence of flows can produce conditions favorable to cavitation. If the Froude number of the incoming flow is large, a free hydraulic jump occurring in the stilling basin can cause spontaneous cavitation. Pressure fluctuations in high velocity flow could produce conditions favorable to spontaneous cavitation. The intensity of pressure is measured by the root mean square value. When the sum of the mean and the fluctuating pressure at a given instant is close to the vapor pressure of water at the ambient temperature, cavitation can be expected. The design of a stilling basin at very high Froude numbers should be such that this source of cavitation is limited. (Small-FRC)
W81-05902

**FLOW REGIME IN HELICAL LONG-PATH EMITTERS,**
Technion - Israel Inst. of Tech., Haifa. Dept. of Agricultural Engineering.
S. Tal, and B. Zur.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 106, No IR1, p 27-35. March, 1980. 2 Fig, 3 Tab, 12 Ref.

Descriptors: *Helical long-path emitters, *Flow characteristics, *Irrigation engineering, Darcy-Weisbach equation, Friction coefficient, Drip irrigation, Pressure distribution, Velocity distribution, Laminar flow, Hydraulics.

The Darcy-Weisbach equation combined with the Poiseville friction coefficient failed to predict the pressure drop and mean flow velocities in helical long-path emitters, which are the principal parts of drip irrigation system. Water flowing through a helical flow path is subjected to centrifugal forces that distort the symmetrical axial flow velocity distribution, resulting in a maximal axial flow velocity close to the outer wall and a steep radial velocity gradient near that wall. Therefore, the frictional forces in the helical long-path emitters are significantly larger than those in straight long tubes. Results obtained in this study agreed well with functional relationships developed for helical tubes. Laminar flow conditions persisted in the helical long-path emitters within their operational range and above the critical Reynolds value for laminar flow. An empirical equation for computing the pressure drop and the mean flow velocity in helical long-path emitters was developed and successfully tested. (Cassar-FRC)
W81-05920

**MODEL FOR THE OPTIMAL PLANNING OF STRUCTURAL FLOOD CONTROL SYSTEMS,**
Natal Univ., Durban (South Africa). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W81-05952

**LINEAR THEORY METHODS FOR PIPE NETWORK ANALYSIS,**
Queensland Univ., Brisbane (Australia). Dept. of Civil Engineering.
L. T. Isaacs, and K. G. Mills.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY7, p 1191-1201, July, 1980. 10 Ref.

Descriptors: *Pipe flow, *Steady flow, *Computer programs, Pipes, Pipelines, Flow, Pressure head, Mathematical studies, Networks.

A linear theory method, described by Wood and Charles, is used to solve for pipe flows. The present method, based on the same theory, is used to solve for junction heads. The method is compared to the Newton-Raphson method and the Hardy Cross method. The method described is particular-

ly useful to civil engineers who wish to write and run their own programs on a mini-computer. The method solves for the unknown heads and therefore requires fewer equations than the method of Wood and Charles. The equations can be solved by the SOR method, which permits the efficient use of core storage space and eliminates bandwidth restrictions. The final solution satisfies the continuity requirement very accurately, and any errors may be interpreted in terms of pipe friction losses. Four tests of the method are described, including one performed on the network described by Wood and Charles. (Small-FRC)
W81-06000

## 8C. Hydraulic Machinery

**LOCKS AND MECHANICAL LIFTS: STATE OF THE ART,**
For primary bibliographic entry see Field 8A.
W81-05750

**ANATOMY OF A SLUICE GATE,**
Hunt (Rodney) Co., Orange, MA.
R. W. Henderson.
Journal of the New England Water Works Association, Vol 95, No 1, p 36-47, 1981.

Descriptors: *Water treatment facilities, *Sluice gates, *Gates, *Flow control, Slide gates, Hydraulic structures, Dams, Reservoirs, History.

The modern sluice gate had a predecessor as early as 4000 B.C. in the Tigris and Euphrates Valley. Since then, it has evolved from a wooden structure called a slide gate through cast iron (later with bronze seatings). The basic design, a frame with movable slide or disc and guides, had not changed for 70 years until 1952 when a resilient seal was installed along the bottom of the disc. Sluice gates, available in sizes up to 16 x 16 feet, are used in dams and reservoirs, water treatment plants, and waste water treatment plants to regulate flow and levels. Problems include wear in the actuators and leakage. A newly designed gate, suitable for water treatment plants, is virtually drop tight, a third of a cup per minute for a 5 x 5 ft gate. Proper maintenance of sluice gates involves removing growths and deposits from the tongue and groove area and lubrication of moving parts. (Cassar-FRC)
W81-05847

## 8D. Soil Mechanics

**CLOSED-SYSTEM FREEZING OF SOILS IN LININGS AND EARTH EMBANKMENT DAMS,**
Water and Power Resources Services, Denver, CO. Engineering and Research Center.
C. W. Jones.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-240491, Price codes: A04 in paper copy, A01 in microfiche. Report REC-ERC-81-1, March, 1981. 52 p, 36 Fig, 23 Ref, 3 Append.

Descriptors: *Frost, *Earth dams, *Banks, *Soil density, *Ice, *Freezing, Reservoirs, Canals, Linings, Soil water, Earthworks, Soil temperature.

Closed-system freezing in a soil is a condition in which no source of water is available during the freezing process beyond that originally in the voids of the soil at and near the zone of freezing. Closed-system freezing has important effects on some soil structures, particularly in irrigation works on compacted soil linings for canals and reservoirs and on earth embankment dams. For compacted soil canal linings, laboratory and field test results show that under certain soil and temperature conditions, freezing decreases soil density near the surface, but increases density at depth. In two soil linings, the average density increased slightly during a 20-year period. It is possible for closed-system freezing to cause the formation of ice on the underside of a plastic membrane lining on a slope which could result in a plane of slippage as the ice melts. The closed-system type of freezing that occurs below the surface of an earth embankment when construction is halted by cold weather may significantly affect soil moisture and density. The depth to which frost penetrates in soil with resulting frost action is determined mainly by cumulative, below-freezing temperatures, degree of shading, snow or other surface cover, and the thermal properties of the soil. Closed-system freezing could occur in embankment soil in contact with a bedrock abutment at depths below those in the embankment, which might produce a condition conducive to piping of the soil. In certain soil and climatic conditions, closed-system freezing can cause soil shrinkage and the formation of cracks which might be detrimental to soil barriers for retaining water. (Moore-SRC)
W81-05754

**GROUND WATER LEVEL CONTROL SYSTEM,**
Fox Pool Corp., York, PA. (Assignee).
For primary bibliographic entry see Field 2F.
W81-05797

**INSTRUMENTATION AND MONITORING OF EXCAVATIONS,**
Parsons, Brinckerhoff, Quade and Douglas, Inc., Boston, MA.
For primary bibliographic entry see Field 7B.
W81-05860

## 8E. Rock Mechanics and Geology

**CHALK SLOPE FAILURE AT GAINESVILLE LOCK, ALABAMA,**
Corps of Engineers, Mobile, AL. Mobile District.
J. H. Bryan.
Bulletin of the Association of Engineering Geologists, Vol 18, No 1, p 55-69, 1981. 17 Fig, 2 Tab, 9 Ref.

Descriptors: *Excavations, *Slope stabilization, *Bock slope stability, Locks, *Gainesville Lock, Alabama, Tension, Rock mechanics, Cracks, Stress, Weathering, Stability analysis, Hydrostatic pressure.

The Gainesville Lock on the Tombigbee River, Alabama, was constructed in a 65 ft deep excavation in 30-35 ft flood plain alluvium overlying the Mooreville Chalk Formation. Although similar excavations in the same formation have been stable for 30 years, the slope on the Gainesville project developed tension cracks in the Chalk within a few months and failed in two places. The face was stabilized by scaling and sloping back to the tension crack. Laboratory tests had indicated that the original excavation was stable with a very high safety factor. A possible mechanism for the failure is horizontal stress relief followed by shrinkage cracking. The maximum tensile stress occurred midway along the berm, where a shrinkage crack occurred as the siltstone dried. The crack gradually deepened and the slope continued its move toward the excavation. Ice wedging or hydrostatic pressure changed the stress pattern, causing the crack to turn toward the face. Blocks dropped out near the toe. Future failures in the Mooreville Chalk may be prevented by using a critical height of 10 feet, keping the slopes and adjacent areas moist to prevent drying and shrinking, using a 3 to 1 vertical to horizontal inclined slope, and retesting cores after they have been weathered for a few weeks. (Cassar-FRC)
W81-05861

## 8I. Fisheries Engineering

**FINANCIAL FEASIBILITY OF HIGH DENSITY OYSTER CULTURE IN SALTMARSH PONDS WITH ARTIFICIALLY PROLONGED TIDAL FLOWS,**
Rhode Island Univ., Kingston. Dept. of Resource Economics.
For primary bibliographic entry see Field 6B.
W81-05868

**FEATURES OF SUCCESSFUL SPAWNING SITE DEVELOPMENT FOR BROOK TROUT IN WISCONSIN PONDS,**
Wisconsin Dept. of Natural Resources, Waupaca.
R. F. Carline.
Transactions of the American Fisheries Society, Vol 109, No 4, p 453-457, July, 1980. 1 Fig, 1 Tab, 11 Ref.

Descriptors: *Trout, *Ponds, Fish, Water quality, Behavior, Eggs, Fish eggs, *Spawning, *Fish establishment, *Wisconsin, Spawning site development.

This report describes initial attempts to augment spawning sites for brook trout in spring-fed kettle ponds, northeast Wisconsin. The method used for developing spawning areas calls for measuring along pond shorelines the hydrostatic head and particle size of mineral soils in order to screen potential development sites. Overburdens of organic material were excavated from sites with appropriate groundwater characteristics and coarse mineral soils. Brook trout constructed redds in both natural and developed sites where seepage velocities ranged from 11.5 to 45.0 cm/hour and about 45% of the substrate, by weight, averaged less than 2 mm in diameter. Because the hydrostatic head in excavated and natural spawning areas was similar, seepage velocities, and hence the locations of redds, were determined by substrate permeability. Spawning-site development contributed to increased recruitment of juvenile brook trout in two of three study ponds. (Baker-FRC)
W81-05910

**WATER QUALITY IN STANDING-WATER PONDS FOR WINTER PRODUCTION OF RAINBOW TROUT IN ALABAMA,**
Auburn Univ., AL. Dept. of Fisheries and Allied Aquacultures.
C. J. Halverson, J. W. Jensen, and C. E. Boyd.
Transactions of the American Fisheries Society, Vol 109, No 3, p 310-313. May, 1980. 4 Tab, 12 Ref.

Descriptors: *Water quality, Standing waters, *Ponds, Lakes, *Trout, Fish, *Fish stocking, Dissolved oxygen, Residual oxygen, *Alabama, *Rainbow trout, Fish production.

Ponds at the Auburn University Fisheries Research Unit were stocked with rainbow trout at 3,700, 6,200, and 8,650 fish per hectare on November 16, 1977. Commercial, floating trout feed was used to feed the fish daily. The average net production values, in order of increasing stocking rates, were 700, 1,130, and 1,640 kg/hectare at harvest on March 16, 1978. Feed conversion values ranged from 1.15 to 1.27. The winter that year was cooler than normal, and water temperatures never exceeded 19C. Feed consumption by rainbow trout was reduced at water temperatures below 10C. Other water quality variables were within desirable ranges for rainbow trout. Concentrations of dissolved oxygen (DO) at dawn were closely correlated with water temperatures. Nighttime dissolved oxygen budgets for ponds indicated that DO dynamics were dominated by diffusion. (Baker-FRC)
W81-05912

**THE EFFECT OF MINERAL ADDITIVES IN FOOD ON BIOSYNTHETIC PROCESSES AND THE GROWTH OF CARP,**
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. Yu. Yevtushenko.
Hydrobiological Journal, Vol 16, No 1, p 40-43, 1980. 2 Tab, 9 Ref.

Descriptors: *Fish, *Growth, *Carp, *Minerals, Copper, Metals, Trace metals, Zinc, Manganese, Magnesium, Nuclear powerplants, Nutrients, Temperature effect, Aquaculture, *Thermal water, Waste heat.

The effect of feeding a range of mineral additives in artificial granulated feeds on biosynthetic processes and on the growth of carp reared in containers in heated wastewater from thermal power sta-

tions was investigated. The mineral additives included magnesium sulfate, manganese, zinc and copper. The mineral additives appreciably influenced the rate of biosynthetic processes in the body of fish and the growth rate. This increased growth rate was accompanied by accelerated biosynthetic processes in the hepatic tissues of the carp, as evidenced by the higher radioactivity of the acid-soluble organic compounds. Magnesium, manganese and zinc sulfates produced an increase in the rate of uptake of the carbon from radiolabelled sodium acetate into the organic components of the bile. Copper ions had an influence on the growth rate and on the trend of metabolic processes. It was concluded that a combination of these mineral additives affects biosynthetic processes in the liver and also the growth of carp reared in warm waters. (Baker-FRC)
W81-05973

# 10. SCIENTIFIC AND TECHNICAL INFORMATION

## 10D. Specialized Information Center Services

**OPERATIONAL GUIDELINES FOR ASSISTANCE CENTERS OF THE NATIONAL WATER DATA EXCHANGE,**
Geological Survey, Reston, VA. Water Resources Div.
M. D. Edwards, and G. L. Thompson.
Geological Survey Open-file report 80-1196, 1980. 81 p, 2 Fig, 8 Append.

Descriptors: *Data storage and retrieval, *Data transmission, *Information exchange, Hydrologic data, Data processing, Publications, Indexing, Training, Information retrieval, *National Water Data Exchange(NAWDEX).

The National Water Data Exchange (NAWDES) is a nationwide program managed by the U.S. Geological Survey to assist users of water data and water-related data in identifying, locating, and acquiring needed data. NAWDEX services are available through a program office located in the Geological Survey's National Center in Reston, Va., and a network of assistance centers established in 45 States and in Puerto Rico to provide local and cnvenient access to NAWDEX facilities. This manual presents operational guidelines for the operation of these assistance centers to accomplish the expeditious flow of data from holder to user. These guildlines will be occasionally modified and supplemented to accomodate new concepts and techniques that may be needed. (USGS)
W81-05708

## 10F. Preparation Of Reviews

**SNOW SURFACE ENERGY EXCHANGE,**
Saskatchewan Univ., Saskatoon. Div. of Hydrology.
For primary bibliographic entry see Field 2C.
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